THE ROMANCE OF MODERN COMMERCE

By
H.O.
NEWLAND

THE IAN HARDY SERIES

BY

COMMANDER E. HAMILTON CURREY, R.N.

Each Volume with Illustrations in Colour. 6s. *net*

Ian Hardy's career in H.M. Navy is told in four volumes, which are described below. Each volume is complete in itself, and no knowledge of the previous volumes is necessary, but few boys will read one of the series without wishing to peruse the others.

IAN HARDY, NAVAL CADET

"A sound and wholesome story giving a lively picture of a naval cadet's life."
—*Birmingham Gazette.*

"A very wholesome book for boys, and the lurking danger of Ian's ill deeds being imitated may be regarded as negligible in comparison with the good likely to be done by the example of his manly, honest nature. Ian was a boy whom his father might occasionally have reason to whip, but never feel ashamed of."—*United Service Magazine.*

IAN HARDY, MIDSHIPMAN

"A jolly sequel to his last year's book."—*Christian World.*

"The 'real thing.' . . . Certain to enthral boys of almost any age who love stories of British pluck."—*Observer.*

"Commander E. Hamilton Currey, R.N., is becoming a serious rival to Kingston as a writer of sea stories. Just as a former generation revelled in Kingston's doings of his three heroes from their middy days until they became admirals all, so will the present-day boys read with interest the story of Ian Hardy. Last year we knew him as a cadet; this year we get *Ian Hardy, Midshipman.* The present instalment of his stirring history is breezily written."—*Yorkshire Observer.*

IAN HARDY, SENIOR MIDSHIPMAN

"Of those who are now writing stories of the sea, Commander Currey holds perhaps the leading position. He has a gift of narrative, a keen sense of humour, and above all he writes from a full stock of knowledge."—*Saturday Review.*

It is no exaggeration to say that Commander Currey bears worthily the mantle of Kingston and Captain Marryat."—*Manchester Courier.*

"The Ian Hardy Series is just splendid for boys to read, and the best of it is that each book is complete in itself. But not many boys will read one of the series without being keenly desirous of reading all the others."—*Sheffield Telegraph.*

IAN HARDY FIGHTING THE MOORS

By writing this series the author is doing national service, for he writes of the Navy and the sea with knowledge and sound sense. . . . What a welcome addition the whole series would make to a boy's library."—*Daily Graphic.*

"The right romantic stuff, full of fighting and hairbreadth escapes. . . . Commander Currey has the secret of making the men and ships seem actual."—*Times.*

"By this time Ian Hardy has become a real friend and we consider him all a hero should be."
—*Outlook.*

SEELEY, SERVICE & CO. LIMITED

THE ROMANCE OF MODERN COMMERCE

Copyright Underwood & Co.] [*London & New York*

SETTLING A DISPUTE

Cowboys examining a yearling's brand to settle a dispute on an Arizona Ranch.

THE ROMANCE OF MODERN COMMERCE

A POPULAR ACCOUNT OF THE PRODUCTION OF CEREALS, TEA, COFFEE, RUBBER, TOBACCO, COTTON, SILK, WOOL, TIMBER, CATTLE, OILS, FURS, PRECIOUS STONES, &c. &c. &c.

BY

H. OSMAN NEWLAND, F.R.Hist.S.

Member of Council of the Sociological Society; Founder of the British West African Association; Lecturer in Commercial History, Sociology, and English Literature to the London County Council

AUTHOR OF
"SIERRA LEONE: ITS PEOPLE, PRODUCTS, AND SECRET SOCIETIES,"
"COCONUTS, KERNELS, AND COCOA," "WEST AFRICA,"
&c. &c. &c.

WITH MANY ILLUSTRATIONS

LONDON
SEELEY, SERVICE & CO. LIMITED
38 Great Russell Street
1920

UNIFORM WITH THIS VOLUME

THE LIBRARY OF ROMANCE

Extra Crown 8vo. With many illustrations. 6s. nett.

"Splendid Volumes."—*The Outlook.*

"The Library of Romance offers a splendid choice."—*Globe.*

"Gift Books whose value it would be difficult to over-estimate."
The Standard.

"This series has now won a considerable & well deserved reputation."
The Guardian.

"Each Volume treats its allotted theme with accuracy, but at the same time with a charm that will commend itself to readers of all ages. The root idea is excellent, and it is excellently carried out, with full illustrations and very prettily designed covers."—*The Daily Telegraph.*

By Prof. G. F. SCOTT ELLIOT, M.A., B.Sc.
The Romance of Savage Life
The Romance of Plant Life
The Romance of Early British Life

By EDWARD GILLIAT, M.A.
The Romance of Modern Sieges

By JOHN LEA, M.A.
The Romance of Bird Life

By JOHN LEA, M.A. & H. COUPIN, D.Sc.
The Romance of Animal Arts and Crafts

By SIDNEY WRIGHT
The Romance of the World's Fisheries

By the Rev. J. C. LAMBERT, M.A., D.D.
The Romance of Missionary Heroism

By G. FIRTH SCOTT
The Romance of Polar Exploration

By CHARLES R. GIBSON, F.R.S.E.
The Romance of Modern Photography
The Romance of Modern Electricity
The Romance of Modern Manufacture
The Romance of Scientific Discovery

By CHARLES C. TURNER
The Romance of Aeronautics

By HECTOR MACPHERSON, Junr.
The Romance of Modern Astronomy

By EDWARD BENNETT.
The Romance of the Post Office.

By ARCHIBALD WILLIAMS, B.A. (Oxon.), F.R.G.S.
The Romance of Early Exploration
The Romance of Modern Exploration
The Romance of Modern Mechanism
The Romance of Modern Invention
The Romance of Modern Engineering
The Romance of Modern Locomotion
The Romance of Modern Mining

By EDMUND SELOUS
The Romance of the Animal World
The Romance of Insect Life

By AGNES GIBERNE
The Romance of the Mighty Deep

By E. S. GREW, M.A.
The Romance of Modern Geology

By J. C. PHILIP, D.Sc., Ph.D.
The Romance of Modern Chemistry

By E. KEBLE CHATTERTON, B.A.
The Romance of the Ship
The Romance of Piracy

By T. W. CORBIN
The Romance of Submarine Engineering
The Romance of War Inventions

By NORMAN J. DAVIDSON, B.A. (Oxon.)
The Romance of the Spanish Main

By H. O. NEWLAND, F.R.Hist.S.
The Romance of Modern Commerce.

SEELEY, SERVICE & CO., LIMITED.

To

MY DEAR DAUGHTER

EILEEN

AUTHOR'S ACKNOWLEDGMENTS

THE author gratefully acknowledges the loan of photographs for illustrating this book from the Queensland Government, the Khedivial Agricultural Society of Egypt, the Great Northern Railway of Canada, Messrs Cadbury Bros. and the British West African Association. He would also like to express his gratitude for help or information received from Messrs Harmsworth, Cadbury and J. T. Nicholls in the compilation of matter in the chapters on Paper, Cocoa, Wool and Cold Storage respectively; and to the Publishers of the author's books *Sierra Leone: Its People, Products and Secret Societies; Coconuts, Kernels and Cocoa;* and *West Africa,* for permission to reproduce certain matter therefrom.

CONTENTS

CHAPTER		PAGE
I.	The Development of Commerce	17
II.	Wheat	28
III.	Tea	41
IV.	Coffee	53
V.	Cocoa	62
VI.	Sugar	73
VII.	Condiments and Spices	85
VIII.	Rubber	97
IX.	Tobacco	117
X.	Cotton	126
XI.	Silk	136
XII.	Wool	142
XIII.	Timber	153
XIV.	Fruit and Wine	167
XV.	Cattle and Leather	178
XVI.	Cold Storage	190
XVII.	Vegetable Oils	198
XVIII.	Mineral Oil	209

CONTENTS

CHAPTER		PAGE
XIX.	Furs	220
XX.	Feathers	230
XXI.	Shells	238
XXII.	Paper	245
XXIII.	Precious Stones	252
XXIV.	Metals	265
XXV.	Aircraft in War and Commerce	287

LIST OF ILLUSTRATIONS

Settling a Dispute . . . . . *Frontispiece*

FACING PAGE

Cutting and Binding Wheat by Motor . . . 32

Plucking the Leaves from a Tea-plant . . . 48

Drying Coffee Beans 56

Plucking Cocoa Pods 64

Gathering the Cocoa Crops 66

Sorting Cocoa Beans 70

Sugar Cane in Queensland. 80

Tapping young Rubber Trees 104

Ripe Cotton before First Picking 128

LIST OF ILLUSTRATIONS

FACING PAGE

Transport of Cotton on the Nile 132

A Merino Ram 144

Vineyards covering the Sunny Fields at Ay . . 168

A Cold Store 192

Native climbing for Coconuts 200

Palm Kernels 200

Future Newspapers 248

ROMANCE OF COMMERCE

CHAPTER I

THE DEVELOPMENT OF COMMERCE

WHO has not heard of the greatness of Carthage, the magnificence of Tyre and Sidon, the wealth of Assyria and the glories of Venice? Who is not proud of the position which Britain—a few little islands in the North Sea—holds among the nations of the world?

Yet how few who are thrilled with the stories of the monarchs and warriors of vanished empires, or who study the statecraft of modern kingdoms, realise that behind the glamour of the thrones, the pomp of the priests and the power of the warrior there lurks a story more fascinating—because it has magnetically influenced each and all alike—the Romance of Commerce. Commerce has created barriers of caste and broken them down. Commerce has built up great nations, then depressed them. Commerce has raised empires on lagoons and deserts, then

> "Folding their tents like the Arabs
> As silently crept away."

In short, talent, hardiness, thrift, perseverance, aptitude and all that we value most in the individual—art, science, literature, religion, and all that we value most in society—all have been profoundly influenced and developed by commerce.

Commerce means the international traffic of goods,

or, in other words, the foreign trade of a country as distinct from its internal trade. Wherever men live or have lived in small, scattered or isolated groups, each supplying its own wants by its own labour and natural resources, there is no commerce, no conflict and no progress. But such groups must always have been, and are, very few. For the passing from hand to hand and tribe to tribe of the copper kettles of the Kamchatkans to the Eskimos indicate how dear even to most primitive tribes is the love of barter, exchange and commerce.

Even at the dawn of history conflict was common among races, and where one group of people was not fighting another group the two were exchanging goods. Sometimes the exchange of goods led to disputes over prices or relative values, or excited cupidity or jealousy of another people's property or prosperity, and caused war. Many fearful conflicts can be traced to such occurrences in ancient times, and many modern wars are waged for similar reasons. One of the underlying causes of the Great European War of 1914-1918 was the extraordinary development of German commerce and industry, her desire for more markets and expansion of territory, particularly of seaboard and open ports.

While, however, commerce may often have caused conflicts, war and conquest have frequently created a commerce and good feeling among peoples between whom no friendly intercourse previously existed. Such were the wars which opened up India, China and Japan to Europeans. Many also of the conflicts caused by commerce led to greater civilisation, freedom and progress. Cæsar tells us that "the merchants" first gave him the information which led to his invasion of Britain; and England owes much to the Roman

roads and ramparts and to the Roman laws which she received from the conquerors, not to speak of the immense commercial intercourse which was established with the Continent by means of a fleet. To the Romans also we owe the introduction into Britain of fruits and vegetables previously unknown to these islands.

In the later internal struggles in Britain for liberty and progress it was the commercial class in the towns which decided the victory. On the Continent also the influence of commerce was so great that prominent ports and cities were able to throw off allegiance to kings, princes and emperors and establish themselves as independent municipalities or states, while forming international alliances like the Hanseatic League. In commerce the German emperors found a grave and modern citizenship a cradle.

Co-operation as well as conflict and competition have played important parts in the Romance of Commerce. The merchant and craft guilds brought peoples of all sorts and conditions together by means of a new bond of interest instead of the old bond of blood. They opened their gates to the runaway serf and decreed that residence within a guild for a year and a day made a man "free." They did more. They raised the standard of handicraft by insisting on good work; and their influence caused special offices and dignities to be conferred upon "merchants" who conducted commerce with other peoples successfully.

The celebrated Hanseatic League, one of the greatest achievements of commerce, stands out conspicuously in the Middle Ages, because, amid robbery, rapine and internecine warfare of the feudal nobility, and between empire and papacy, it was able to hold aloof from all and act as a court of arbitration for conflicting interests,

while it amassed and organised a powerful fleet which made war only for mutual protection.

A consideration of the part which commerce played in the Middle Ages in the development of the wealth and freedom which we enjoy to-day reveals to us at least two great factors which determine the growth and importance of commerce. The first is the means of transport and the second is the medium of exchange.

To take the latter first. In the first beginnings of commerce between primitive peoples one article is bartered for another. This primitive mode of commerce can be seen to-day along the Siberian and Chinese frontiers—*e.g.* at Kiakhta and Miamatchin, where chests of tea are exchanged in bulk for furs and manufactured cotton or woollen goods. Among pastoral people, flocks and herds being the principal source of wealth, these are in turn used as a medium, as they are to-day among some peoples in Africa. The next step in the exchange of commodities is to attach certain values to shells, pieces of metal or some other durable articles, which are then passed from people to people as a medium of exchange, as is done to-day among agricultural peoples in the interior of Africa. The story of the coming of money and its significance in commerce is told in the chapter on metals. From the time when money was introduced the possession of this means of exchange has been coveted and valued above the commodities of commerce, and has frequently played a greater part in maintaining peace, declaring war or emerging victorious from conflict, than arms or men. Small wonder, then, that many people have regarded it as "the root of all evil," and denounced usury and other traffic in money, leaving such practices to the Jew and outsider. Yet money-lending did not originate with the Jew, and traffic in money has been of enormous

value to commerce and civilisation. Most of this traffic has not been in metal money, but paper money representing it. The Greeks originated "bills of exchange," the Babylonians mortgages, and the Romans developed primitive banking, lent money and invented book-keeping by double entry. In mediæval Europe the bankers of Florence and other Italian cities rose to sovereign power.

More romantic still is the story of the evolution of the means of transport.

Among primitive societies, apparently, the people who first acted as traders or intermediaries were outcasts and Ishmaels. They carried their lives in their hands, and consequently were more fearless and daring, besides gaining more knowledge and less prejudice in their intercourse between peoples. Sometimes they were tolerated from pity, and some of them were adopted into alien tribes. Thus was commerce peacefully developed. Sometimes, however, they would be spurned or attacked, then they would plunder or kill, and their hand would be against every man's. The Bible shows us the Ishmaelites as traders in spices and all other goods, including human flesh, buying Joseph from his brothers and carrying him to Egypt. Caravans and river boats were the first means of transport, and these primitive methods are still used inland in the tropics. In the interior of Africa the author has himself, in the twentieth century, carried up European goods and brought down rice, kernels and other native produce by canoe or hammocked it with carriers through the bush, no other means of transport being available in many parts. In Northern Africa, in many parts of the East and in the Far West, transit by caravan is still a favourite method, even when it is not the only means.

The wealth accumulated by those primitive traders

who knew how to use and consolidate this source of power soon made them very formidable. Where they could organise themselves along coasts, they made coasting voyages. Then, braving the unknown seas, they became explorers, and taught man what he has never forgotten, that the greatest power of commerce lies in ships and in the control of the sea.

The Phœnicians were the great traders and explorers of antiquity, and their power became all the greater because the Egyptian people and, for some time, the Greeks, despised the trader, and therefore employed the Phœnicians to perform all such work for them.

Later, Greece learnt the lesson, then Rome, although among neither of these peoples did the man of commerce rise to the highest rank.

To the Italian republics and the cities of the Hanseatic League belongs the chief credit of having honoured the trader and commercial man, although during the reign of Athelstan the Anglo-Saxon kingdom ordained that the merchant who built a ship and crossed the seas in it thrice was thaneworthy.

Greece and Rome recognised the importance of sea power ; so also did the Hanseatic League and the great republics of Venice, Genoa and Pisa. Each in turn, consequently, achieved wealth and greatness. Later, the Spaniards recognised it also, and for a time became the greatest country in Europe through the commerce acquired thereby.

The conflict of Britain with Spain—made memorable by the destruction of the Spanish Armada, the exploits of Drake, Frobisher, Raleigh, Hawkins and other adventurers, and the foundation of our Colonial Empire —was the first successful attempt of our island kingdom to acquire a place in the sun as a commercial or a naval nation. Alfred's navy had been manned by Frisians,

and the Danish conquests disposed of all Anglo-Saxon claims upon the sea. For many years after the Norman Conquest the commerce of England was mostly in the hands of foreigners, and the claims of Edward III. and the Henrys to the sovereignty of the seas ended in failure, while outlaws pillaged our coasts during subsequent reigns.

Previous to the period of Queen Elizabeth England was of but little account as a maritime nation. From that time our mercantile marine gradually increased, until at the Restoration the British shipping cleared outwards amounted to 95,266 tons; ninety years later it amounted to 190,533 tons; now British shipping amounts to more than 65 per cent. of the whole world's traffic. Until about seventy years ago the whole of our foreign trade was done by means of sailing vessels, but the introduction of steam navigation gave an impetus to our carrying trade, and at the present time Great Britain possesses more than half the merchant service of the world, which means that more than half the overseas commerce of the world is carried under the British flag. The vast importance of that commerce and the inestimable value of a great and good navy to protect it and our shores were never more forcibly demonstrated than during the Great World War recently forced upon us.

Throughout Europe and America also, and the more civilised states of Asia and Africa, commerce has been facilitated by vast improvements in the means of internal transport.

England is intersected by many excellent roads, used for the conveyance of merchandise and local traffic. Most of the existing roads were constructed before the commencement of the nineteenth century; several were planned and constructed by the Romans. One of the

oldest and most frequented of these roads was that known as the Great North Road, from London, through York, to Edinburgh. A century ago stage-coaches for passengers and stage-wagons and pack-horses for merchandise were the chief means of transport. The stage-coach was much the fastest of the three, yet up to the middle of the eighteenth century the journey by coach from London to Edinburgh, provided the weather was favourable, took a fortnight, and the coaches only ran once a month. Early in the nineteenth century, owing to improved roads and better-built coaches, the journey was accomplished in about forty-three hours. The advent of railways, about sixty-five years ago, gradually caused the disappearance of the stage-coach, the pack-horse and the stage-wagon.

The iron roads, which were regarded with much superstition and fear for many years, have everywhere proved of inestimable value to commerce. By their means vast tonnage can be transported from one end of a country to the other within a few hours, and the travellers, buyers and merchants of commerce can pay quick visits to their clientele at home and abroad, and come into personal contact with them in a manner which was impossible years ago.

The importance of railways was especially noticeable in the Great World War of 1914-1918 by the manner in which the German troops and stores were expeditiously transported from one end of Germany to the other, and into the countries of the Allies, by previously planned and well-developed railroads. The lack of such railroads and their development was felt by Russia in particular during the transport of her troops, and when her sea routes by the Baltic and the Black Sea were largely blocked by mines. Archangel, the port for the northern route, was approached only by a single-track railway,

which soon became inconveniently congested. To their credit, be it said, the Russians immediately took steps to double track the line as far as Niandoma, about half-way to Archangel, and to build a railway from Petrograd to Kem.

Finally, one must not forget the part which canals have played and still play in the romance of commerce.

Canals have existed in this country for several centuries. As far back as the reign of Henry I. (1121) there are records of legislation with reference to canals in Lincolnshire. Most of those canals now in existence were constructed, however, about the end of the eighteenth or the beginning of the nineteenth century. Of about 4000 miles of canals in the United Kingdom about 1200 miles belong to the railway companies, which do not encourage canal traffic. The greatest, but not the longest, artificial waterway in England is the Manchester Ship Canal, which extends from near Liverpool to Manchester, a distance of 35½ miles. It is 172 feet wide and 26 feet deep, thus enabling ocean steamers of 6000 tons' register to proceed up the canal and discharge their cargoes at the Manchester docks.

Canals mean more to our Continental neighbours than to us. By their means the Low Countries acquired wealth, and by their means the Belgians held at bay the Germans.

France has a magnificent system of canals, ascending and descending mountains, and crossing and recrossing in all directions. In fact, on the Continent generally, rivers and canals are the great commercial highways, and vast sums of money have been spent in the construction and maintenance of these highways. A striking example of the elimination of distance resulting from the cheap cost of carriage on these waterways may be mentioned.

In the heart of France there is an immense button manufactory, which sends out buttons on cards all over the world. The buttons are made of crushed feldspar, which is found not more than 100 miles from the manufactory. Yet all the feldspar out of which these French buttons are made comes from the mountains of Norway. It is carried in sea-going vessels to Rouen and thence by canals to the centre of France. Owing to the cheapness of this water carriage, Norway is nearer to the French manufactory than are the French mountains, only 100 miles distant.

Last but by no means least are those greater canals which connect great waterways in such a way that they not only quicken commerce, but influence the destiny of nations. The Suez Canal, controlled by Britain, the Panama Canal, controlled by the United States, and the Kiel Canal, formerly controlled by Germany, have achieved a world-wide fame and wonder.

Through the constant clash of commercial interests and the conflicts of nations on the great highways of the world new understandings and agreements have been arrived at between peoples, just as customs and laws have regulated the internal life of each of the commercial rivals.

With increase of population greater needs have arisen both for the stimulation and the protection of commerce, and fresh laws increase trading facilities and protect commercial interests. Civilised nations, although still rivals, have entered into mutual agreements in the form of international laws and commercial treaties, which afford a measure of security for their respective trading operations. Once a dishonest trader could evade justice by flying to another country; but since 1870 so many extradition treaties have been effected that there are few places in the

world where the fugitive can find a safe asylum. Those nations who have entered into treaty with the country of which the defaulter is a subject, are bound to deliver him up when formal application is made by his own Government.

Thus commerce has evolved from tribal barter to national intercourse, and from national differences to international agreements.

CHAPTER II

WHEAT

A LOVE romance at once historic and pathetic is associated with the commerce between Alaska and California at the beginning of the nineteenth century, whereby cargoes of corn from the latter country saved the starving Russian settlement in Alaska. The people of that settlement, while they had furs and fish in plenty, possessed neither grain nor vegetables, so they sought to exchange skins with the Californians for wheat, barley, beans and fruit. But the Spanish, who then ruled California, forbade trade with foreigners, and Don Louis de Arrillaga, the Governor, refused altogether the negotiations which Nikolai Rezanoff, the Russian Imperial Commissioner, attempted to open between the two countries. The pleading of the latter, a manly and accomplished Muscovite, awakened the love of Concepcion, the fifteen-year-old daughter of the *commandante*, Don José De Arguello. She was a beautiful and graceful girl. Rezanoff told her he would die rather than go back without food for his people, and she in her turn assured her father that she would follow her lover to the grave. The father, therefore, partly by threats, and partly by inducing the friars to declare it a flouting of Providence to prevent commerce between the two countries, prevailed on the Governor to repeal the laws. Rezanoff returned with the grain, vegetables and fruit. Then he set out to Petrograd to gain his master's consent to the marriage. To get there quickly he travelled over-

land across Siberia and Kamchatka, and on the way was killed by a fall from his horse. His betrothed waited for him year after year, vainly watching for the ship which never came.

> "So each year the seasons shifted—wet and warm and drear and dry;
> Half a year of clouds and flowers, half a year of dust and sky.
>
> Yet she heard the varying message voiceless to all ears beside;
> 'He will come,' the flowers whispered; 'Come no more,' the dry hills sighed.
>
> Still she found him with the waters lifted with the morning breeze,
> Still she lost him with the folding of the great white-tented seas."

On the ashes of this romance was founded the commerce between Alaska and California, and paved the way for the temporary Russian occupation of territory in California.

Centuries, however, before the date of this little romance, an incident in connection with the commerce in corn is narrated in the Bible. The great granary of the ancient world was Egypt, although Assyria seems to have been for a long time a formidable rival, Herodotus telling us how the latter country irrigated its fields of grain instead of allowing the river to overflow its fields, as in Egypt.

In Egypt, we are told, the foresight of Joseph led to the preservation of the crops during bountiful harvests against years of possible famine. As a consequence, in the lean and hungry years the peoples of surrounding countries came to Egypt for corn, and among them the brothers of him whom they had sold. The subsequent adventures of the Israelites and the rise of the Jewish nation can thus be traced to commerce in corn.

Now Egypt could and can grow many kinds of corn, wheat, barley and millet. For the term "corn"

includes all cereals or farinaceous plants. In England it is used widely for oats, wheat, barley, or rye, but principally for wheat. In Scotland it is used generally for oats, and in America for maize, while in Africa millet, and in the East rice, is included in the term.

More than half of the world's population subsists mainly upon rice, and such value is attached to it that in the Chinese annual sowing of important food plants, inaugurated in 2800 B.C., rice has to be sown by the Emperor himself. From Asia the cultivation of and commerce in rice spread to Europe, Africa and America, but none of these continents can rival Asia in the production of rice, and all of them import it from the East in varying quantities. Three-quarters of the rice consumption in the world is from the rice-fields of India, principally Bengal and Burma. In Africa vast forests have been cut down for the cultivation of rice, and the particular kind of rice grown in West Africa, especially in Sierra Leone, is more nutritious than that cultivated in Asia, only its colour precluding it from popularity outside Africa. It is used by many of the white population on the west coast of Africa in place of the potato, and the writer has participated in the purchase of rice far up in the hinterland of Sierra Leone and in its transport by native canoe to the European settlement on the coast. He has also participated in pounding the "dhurra"—another kind of corn sometimes called guinea-corn—into a porridge called by the natives "kuss-kuss," and has encouraged them in growing maize as a more nutritive and profitable corn than the guinea-corn, which is more akin to millet.

Maize is said to be more nutritious than other cereals, including wheat, and, with the outer husk removed, is easily digestible. The germ of the grain, however, has a somewhat disagreeable odour, which renders maize

unsuitable for making bread palatable to Europeans, unless mixed with about 25 per cent. of wheat or rye flour. In parts of Turkey and Asia Minor bread is made of this mixture, but owing to an inadequate proportion of wheat, only the poorer Turks eat it. The Yucatan Indians prepare from maize some delicious cakes called "tortilla"; and in Italy "polenta," a porridge prepared from maize, is an important food of the people. Many other European peoples, including ourselves, use maize or corn-flour for making puddings and biscuits, or as a substitute for arrowroot.

Although maize is everywhere used now in some form or another, it was not apparently known to the Old World before the discovery of America. Reference is made to almost every other cereal in Europe, Asia and Africa from very remote times, but maize, only after the fifteenth and, in some cases, the sixteenth centuries. Yet maize can boast of a romantic antiquity in the New World. The grain was found in the ancient tombs of the Incas, dating back nearly two thousand years; and Darwin discovered it buried to a depth of 85 feet upon the shores of Peru.

An annual grass, with a solid stem and with large leaves of various colours, green, yellow or red, according to the varieties of the plant, of which there are many, this handsome and nutritious cereal rapidly became famed throughout the Old World. In Holland and Hungary it is called Turkish wheat, in Central France, Spanish corn. In Hungary, Turkey, Italy, Spain and the south of France it is extensively grown, but the United States and Argentina are the two principal maize-producing countries of the world, which export it in huge quantities. In the United States the crop surpasses that of cotton, and Kansas is the principal state in which it is cultivated, while the Argentine

Republic has over 5,000,000 acres devoted to maize, and its export in this foodstuff is increasing even faster than that of the United States. During recent years there has been a spirited competition between these two countries for the English markets, the Argentine trying to get their crop ripened and exported before America.

The seed is sown early in May in well-watered soil previously prepared by plough and harrow. The rows are about three and a half feet apart, two feet being allowed between each plant. All the soil cultivation is now performed by machinery, although for many years that of the Argentine was performed by European immigrants. After the harvesting of the maize cobs they are threshed or " shelled " by machinery. Huge freight cars transport the grain by railway to the coast, great care being taken to keep the grain dry. Three-quarters of the loss on Argentine corn exported to Europe is caused by the dampness of the grain, and it is no easy matter to secure dryness. Shipping has frequently to be undertaken in wet weather; the air of the country itself is humid; and the ship may not sail for many days from the time it receives this particular cargo. Damp grain frequently ferments on the voyage, but with hatches battened down and hermetically sealed much has been done to diminish this difficulty.

" Oats " is a more popular corn in the British Isles, particularly in Scotland, and its grain is very nutritive. In Russia also the oat crop is one of the most important in the country; and it was maintained by many experts in the Great European War of 1914-1918 that the " oat-eating " soldiers of Scotland and Russia showed the most endurance. The oatmeal which these people love is obtained by grinding the grain after it has had the husks removed and been kiln-dried. It requires

By permission of the] [*Canadian Northern Railway*

CUTTING AND BINDING WHEAT BY MOTOR IN SASKATOON, SASKATCHEWAN

The motor shown above is working four reapers. By this means an immense amount of time and trouble is saved.

long cooking to become digestible, and is frequently adulterated with barley meal. This adulteration can be detected by the microscope, as the granules of the barley are round, and larger than those of the oat.

For a long time there was a popular idea that oats were originally obtained from Robinson Crusoe's Island, but this theory is quite exploded. Its grains have been found in the lake dwellings of Switzerland, and reference is made to the oat in a Chinese historical work on the period A.D. 618-907. Oats grow readily on waste ground, like wild weeds, hence the expression "sowing one's wild oats," "oatmeles" being a term applied to some profligates who infested the streets of London in the seventeenth century. The competition of Russia and the Argentine for the British market forced the price for oats very low before the Great World War.

Barley is another corn of very great antiquity. Pliny, indeed, regarded it as the most ancient foodstuff of man. Certainly no less than three different kinds of barley have been found in the Neolithic lake dwellings of Switzerland. Being a hardier plant than other cereals, it can be cultivated in colder regions. In Russia, indeed, it is found up to the shores of the Arctic regions, and in the northern countries of Europe it was once the principal corn used for food. Unleavened barley cakes are still used by the poorer classes in Scotland. To make them the barley is passed between the rollers of a mill. This removes the outer hard cuticle. The barley is then called "pot barley." To produce "pearl barley" there is a further grinding.

Barley, however, is now used mostly for supplying malt to the brewers. To meet this demand its cultivation is no longer confined to northern regions. In France, Turkey and Southern Russia barley is extensively grown.

To prepare malt the barley is soaked in water and allowed to germinate in a good temperature. This produces a ferment known as diastase, which converts the starch in the grain into sugar. The diastase is developed when the rootlets are about two-thirds the length of the grain. The malt product is then ground in a mill and placed in a vat of running water, the mass being stirred to extract the starch and diastase. By pouring boiling water into the vat the temperature is raised to nearly 140° F., and by this infusion, after about four hours, the starch is converted into sugar. By adding brewers' yeast to the liquid the sugar is converted into alcohol and carbon dioxide.

Mortimer, in his book on Husbandry, remarks: "In Kent they brew with one half oat malt and the other half barley malt."

The game called "barley-break," described in Sir Philip Sydney's *Arcadia*, and once common in England and Scotland, but now only played in Cumberland and Aberdeenshire, derives its name from being played in a corn-yard.

Rye is another kind of corn, immense quantities of which are raised in Scandinavia and Northern Germany, where rye or black bread is a prevalent foodstuff. In Russia it is regarded as the most important cereal, that country cultivating the crop more than any other country, and its annual output being twice as large as its wheat crop. Rye is sown in Viatka and other parts of European Russia in the autumn, but in Tomsk and Tobolsk, in Siberia, it is sown in the spring. The usual method is to sow by hand, cover with a harrow, and reap with a sickle.

There are fewer varieties in rye than any other cereal, and it is of more recent origin than any of the other kinds of corn in the Old World. No grain of this corn

has been found in the Swiss lake dwellings, and although it has been found growing wild as a weed in the wheat-fields of Afghanistan, and also in Turkestan, it is not mentioned apparently in ancient records, or found, like other cereals, in the Egyptian tombs.

Last but not least of the different kinds of corn, in fact by far the most important, is wheat.

Wheat has been cultivated by man from time immemorial. The oldest of legends, the most ancient of monuments and manuscripts speak of and describe it as a familiar friend. But even to antiquity more than one kind of wheat was known ; at least three varieties are in general use to-day; and one or two of these varieties may be subdivided into several different classes. Small "spelt" or one-grained "spelt," for example, was used by the primitive people in the famous lake dwellings in Switzerland. It is still grown in that country, and in France, although Spain produces more of this kind than any other modern country. Each little branchlet of this kind of wheat contains but one grain, other wheats containing at least two and sometimes more grains. It grows on poor soils and the yield is small. The larger spelt was cultivated in Egypt, ancient Greece and Rome. The Romans distributed it through the Roman Empire. Some kinds of this spelt have ears like the best wheat, others are bearded like barley. The two-grained spelt, sometimes called starch wheat or rice wheat, and sometimes *emmer*, its German name, has bearded ears, and the grains vary in colour, according to where it grows, as in Switzerland, Serbia, Italy or Spain. It has become popular in the dry regions of North America, where it seems to succeed under "dry" farming. Polish wheat, another important variety, has large blue-green ears, and its straw is

often solid instead of hollow. It is cultivated chiefly in Spain, but its yield is small.

The ordinary "wheat" of commerce is of several classes. Of these the most important are the "common" wheats, which are all valuable for bread-making; the hard or flint wheat, with a hard grain and plenty of gluten, and therefore used principally for macaroni-making in Spain, Italy, North Africa, Russia and Turkestan; dwarf or hedgehog wheat, with thick, strong straw, growing on the poorer soils of Turkestan, Chile, Alsace and the Austrian Alps. To know the differences in these kinds of wheat, their soil and climatic requirements and the right time for sowing each variety, is necessary for success in commerce in corn.

A sad story is told of an experiment in corn in France just after the Franco-German War of 1870-1871. Some of the French provinces had been so devastated by the war that it was impossible to sow their wheat in the autumn. When springtime came, however, the war had ended. But the seed corn saved by the peasants had either been eaten during distress or was useless for sowing in the spring. One of the Distress Committees, therefore, distributed corn seed which they knew was sown in England in the spring and had produced excellent results. They forgot that the hot, dry summer arrives earlier in France than in England, and that it is hotter and drier. The consequence was that this crop was an entire failure.

As wheat is easily choked by weeds, it is sown upon land upon which has been previously grown some plants which kill weeds. Beetroots and turnips are often used in the North, tobacco in the South.

When the seed is sown broadcast by hand, as on small farms, the harrow is passed over the field to make furrows for it. Some sowing-machines also distribute

the seed broadcast, but the more modern ones drill the soil, sow the seed in the drills and cover them over at once.

The first leaves appear in about a fortnight and with careful weeding grow quickly, all the nourishment mounting from the roots to the ears. When the grain in the ear has become firm to the finger-nail the corn is reaped.

Reaping is a time of joy to all peoples, whether it be done with the reaping-hook and scythe, as in small farms, or by modern machinery drawn by horses or motors, reaping, cleaning and threshing the wheat and putting it into bags simultaneously, as is done in the great corn-fields of Canada and the Far West. The poorest of the poor share in the joy of harvesting, for, from time immemorial, when the corn has been harvested into sheaves the poor have been privileged to glean freely from the ears left on the field. And when the harvest is gathered in, supper, singing, dancing, and many quaint ceremonies mark the general rejoicing.

To primitive man it must have seemed a miracle that from a handful of dry seeds, fields of waving corn and other produce will grow; and, with his rejoicing, came the fear that the gods might deprive him of his happiness unless they were propitiated by sacrifice. We of to-day have outgrown some of the fears and fancies of our forefathers, but we still rejoice at the harvest and have our harvest festivals and thanksgivings.

Corn, when gathered in, is heaped up not higher than two feet in barns without fissures or chinks, to protect it from rats, mice, birds and grubs. From here it is either taken to the mill to be ground into flour, or placed on rail or ship for export, or stored for future use or sale.

Large firms have iron rooms for storing, while in Asia and Africa subterranean silos or pits are dug in the

soil for the purpose. In Chicago and other American centres large storehouses retain the corn until it is likely to fetch the highest price, or until the large steamers come to the quay for loading.

Europe produces about half of the total supply of wheat in the world, North America coming next. The wheat of North America was introduced there from Europe, and it has been maintained by some eminent authorities that the consumption of wheat has determined in no small degree the progress of the world. Wheat, which contains more nitrogen than rice or maize, was first grown in the Mediterranean area, and from there civilisation has spread throughout the world.

In all the battles for Empire the wheat-eaters have conquered the maize-eating people and many of the rice-eating people. Viewed in this light, there was good reason, a short time ago, for a prominent newspaper urging the adoption of " standard " bread, for at that time " white " flour was being deprived of nearly 40 per cent. of actual wheat.

Besides being used for our ordinary bread, wheat is also employed for the unleavened bread of the Jews and the wafers of the Roman Catholics, while from the harder kinds vermicelli and macaroni are made in small tubes or cylinders manufactured in large kettles pierced at the bottom to admit steel wires formed like a U through every two holes. The wheat paste is then forced through the tubes, which are afterwards dried in the open air on Italian or French roofs before being packed and exported in boxes.

During the Great World War the price of wheat rose rapidly, and in England a National Committee was formed to look after the interests of the working classes. This committee at one time recommended the Government " to take possession of all the stocks of wheat in

the kingdom, paying for them at the rate of 35s. or 40s. per quarter, sell them at current market prices, and, in case of a surplus, to pay a bounty of 5 per cent. to the owners and the balance to the State revenue." The Government was also asked to regulate freights, as much of the increased price was caused by the charges of the shipping companies for carrying. In Germany the Government took over the control of all kinds of corn early in the campaign and, later, issued bread-tickets, while obliging rich and poor alike to use bread made of potato flour mixed with wheat and rye in smaller proportions.

Commerce in wheat is extending yearly, and in England alone over 25,000,000 sacks of flour are used for bread and pastry-making.

The shipment of grain from America and Canada is conducted under an excellent system of inspection and guarantee. Upon its shipment a certificate is given by an official inspector, this certificate being an accepted proof of the exact quality of the grain. No buyer asks for other guarantees, even for a whole shipload involving a sum of perhaps £20,000.

When the carrying ship is one of a line of steamers the captain may visit no port of call before reaching his destination; but in many cases the grain-ships do not know at which port they are to discharge their cargo when they start upon their voyage, in which case they call at the nearest port and there receive by telegraph their final orders.

In Argentina and Russia the wheat is sold by sample for "fair average quality of the season," and the sample is sealed. Dock charges are high, particularly in war-time, and even in normal times, when labour is plentiful, discharging occupies day and night.

The samples of wheat and flour are shown at the Corn

Exchange, Mark Lane, where for three days in the week enormous transactions take place, one man sometimes purchasing a shipload. All the information concerning grain imports to the United Kingdom is posted daily in the Baltic Mercantile and Shipping Exchange, St Mary Axe, London, which corresponds to the Stock Exchange, only the prices are fixed for food commodities instead of shares, and gambling takes place in cargoes instead of paper.

CHAPTER III

TEA

NATIONS change their habits as the centuries roll on. A few hundred years ago our ancestors drank beer with every meal, and among the rules and regulations of more than one of our Public Schools may be discovered the provision, by the founder, of the " glass of beer " for each scholar. To-day all this has passed away. We are fast becoming a nation of tea-drinkers. The " afternoon tea " is a recognised English institution, which is being rapidly adopted in many European countries. Tea-rooms, tasteful and tempting, are to be met with in every English town and suburb, and in all the large stores and establishments frequented by Englishwomen.

In many a British home also tea has become the beverage of the breakfast-table as well as retaining its place in the afternoon's affections. In pleasure and sorrow alike it has become a friend, almost, indeed, a necessity of life.

Three centuries ago tea was practically unknown in this country ; only since 1840 has it become a common household drink. First mentioned in Europe by Bolero, in 1590, it was introduced into England by the Dutch between 1610 and 1650. It is mentioned by an English East Indian official as " chaw " in 1615.

A regular tea-house was opened in Exchange Alley, London, in 1657, and a public advertisement appeared in 1658 regarding the new drink " Tcha," " Tay," or

"Tea." Thomas Garraway appears to have been the first English tea dealer.

In his diary of 28th September 1660 Pepys writes: "I did send for a cup of tea (a China drink) of which I had never drunk before. . . . Home—and there found my wife making of tea, a drink which Mr Pelling, the Pothicary, tells her is good for her cold."

The price of the commodity was then from £6 to £10 per pound, and a sovereign of those days was worth many times as much as one of to-day. A present of £2 and two ounces of tea made by the English East India Company to Queen Catherine of Braganza, the wife of Charles II., was considered "a handsome gift." Tea was then and for some time afterwards pronounced *tay*, the poet Pope in his *Rape of the Lock* making it rhyme with "away" and "obey."

The Merry Monarch was indebted to the new commodity for part of his income. In 1660 a number of excise duties were granted to him, amongst which was the following:—"For every gallon of chocolate, sherbet, and tea made and sold, to be paid by the maker thereof . . . 8d." In a later reign a duty of 5s. a pound and 5 per cent. on the value of the leaf was imposed. Little did our statesmen dream then that before a hundred years had passed this tax on tea, extended to our colonies by an unwise politician and a self-conceited monarch, would cause Great Britain to lose some of her most valuable possessions. Yet few incidents in the romance of commerce figure so vividly on the historic page, or were fraught with such serious results, as that which happened in 1767, when our American cousins, disguised as Mohawks, boarded the vessels in Boston and New York harbours and consigned the boxes of tea thereon to the waters.

Since 1840 the tax on tea has been gradually reduced,

until to-day it is only a few pence on every pound imported. Tea has become increasingly popular since that date, and some countries which tax almost every other import admit tea free. Even the Germans, who before the Great World War were comparatively small consumers of tea, are said to have acquired in the trenches a taste for this drink.

It seems almost incredible that a beverage so popular should have been known and used by Eastern people more than a thousand years ago. As far back as 2700 B.C. a Chinese writer mentions the tea plant and the use of its leaves; and although it appears to have been used only as a medicine for many centuries, it had certainly become a common and popular drink by A.D. 793, when a tax was levied on its consumption by Tih Tsung. In A.D. 850 it was mentioned as a common beverage by Soliman, an Arabian merchant who was then travelling in China. From China tea seed was taken to Japan, and there cultivated in the thirteenth century.

The original home of the tea plant is believed to have been in Assam, where it grows wild, attaining an extraordinary luxuriance; but it was in China that it was first properly cultivated and its product used as a commodity of commerce. The Chinese were very jealous of their tea gardens, preventing foreigners from visiting them, and leading the world to believe that "green" tea and "black" tea came from different plants. Robert Fortune, an English botanist travelling in China, first dissipated this theory, discovering that the difference was due to processes of manufacture and that much of the "green" tea in particular was adulterated by colouring matter consisting of gypsum and Prussian blue.

Owing to the large demand for tea and its great

commercial value, other countries have taken up its cultivation, notably India, Ceylon, Java and Japan. Small plantations to supply local wants have also been opened out in Natal, the Caucasus, Jamaica, Burma, Fiji, Tonquin, West Africa, and the Andaman Islands. Japan is the principal exporter to the United States, while Java has the trade to Holland and Australia.

China exports everywhere, but has lately lost some of her markets, owing to the Indian and Ceylon competition, which has increased amazingly during the last sixty years.

The methods of manufacture in these different parts of the world are somewhat different, but the distribution of the product is practically the same. As we are more concerned with the distribution, we will confine ourselves to the growth and preparation of the commodity in India and Ceylon, and trace its career until it arrives in the hands of the retailer.

The first Indian tea plantations were laid out at Kumaon, in the Himalayas, in 1833, with imported plants from China, but in 1837 the indigenous plant *Thea Assamica* was cultivated so extensively in Assam that 488 lbs. of real Indian tea were sent to London the following year, fetching 9s. 5d. per lb. From that time the name "Assam" began to be a valuable passport to the European markets, but other districts were slow to cultivate the indigenous Indian shrub.

The introduction of the Chinese plant into India has proved a great hindrance to Indian planting. For long it was believed that the China bush was the only suitable one, and it is only within the last generation that it has been found that the variety of the tea plant which is indigenous to Assam is far superior, both in hardiness and yielding qualities, to the plant imported from China.

Now, many of the older plantations planted with

China seed have been abandoned, and in others the China bushes are being uprooted year by year, to be replaced by those of the indigenous variety.

The largest tea districts of India are: Assam and Eastern Bengal, with over 400,000 acres; Darjeeling, with over 50,000 acres; Madras and Travancore, with about 40,000 acres; and the United Provinces and Punjab, with nearly 20,000 acres. Something like 250,000,000 lbs. of tea are produced annually in India alone. The United Kingdom annually buys about 400,000,000 lbs. avoirdupois from the various tea-producing countries, Russia being the next best customer. Australia, New Zealand, Canada and the United States also take large quantities, and Persia takes a small quantity. About 60,000,000 lbs. of the United Kingdom's tea imports are resold to foreign countries.

The rise of the tea industry in Ceylon has a romance of its own. About 1860 a terrible fungoid disease ravaged the coffee plantations, causing great distress and enormous loss, as that commodity was then the most important produce of the island. With undaunted hearts the planters tried crops of cocoa and cinchona, but little success met their efforts until they experimented with tea. Then Fortune smiled on their energies and helped them in another way, besides giving them success in planting. The value of silver dropped and dropped. Now, as tea was sold in Great Britain for gold, and this had to be exchanged for silver rupees in order to pay for the labour and upkeep—because silver is the currency in India and Ceylon—it is obvious that as the silver fell in value from 2s. to nearly 1s. the cultivation became cheaper and cheaper, until by 1893, when the value of the rupee became fixed definitely at 1s. 4d., the first tea planters had reaped a

rich harvest. Those who planted when the rupee was below 1s. 4d. were, of course, sufferers, and were in some cases obliged to look to other commodities to reimburse themselves.

Turning from the planter to the plant and the labourer, the first stage in the career of the tea from the bush to our table is known as "plucking the leaf." A tea bush left to its natural course has a periodical growth of leaf called "flushes" or "shoots." This is checked in the tea garden and fresh shoots show themselves in consequence at the axils of the leaves below. Every week or ten days, for about nine months in the year these shoots are plucked with two or three leaves, according to the discretion of the owners. The bud at the tip of the shoot gives the delicate golden-coloured tip which adds so much to the appearance and value of the best. The next two leaves provide the commoner qualities, and where a third leaf is plucked it yields the coarsest leaf.

The broken leaves, stalks and fragments of large leaves are compressed into blocks of various sizes, some lightly squeezed into a loose mass and sewed up in cowhide bags, others into cakes bearing gilt characters, but leaving little trace of the original leaf formation. This is known as "brick tea," and sold to the numerous tribes in Central Asia, who stew it with salt, butter, milk, or other fat and eat it as a vegetable.

"Maté," or "Paraguay tea," as it is called in Britain, is scarcely a "tea" at all, though the leaves of the plant, the South American holly, are similar, and the amount of tannin almost the same. It contains ·2 to 1·6 per cent. of caffeine and is said to be good for insomnia and nervous disorders, but its taste is rather bitter. In South America it is prepared in a small calabash and sucked through a tube called a "bombilla,"

about six inches long, sugar and hot water being first placed in the calabash, then the "maté," and finally boiling water and hot milk. Some people use burnt sugar or lemon instead of milk, and the "peones" or South American labourers will drink as much as twenty cups a day, considering it both food and drink.

To return, however, to the growing of the real article. The quality of the tea is partly dependent on the soil onw hich it is grown. Generally speaking, the slower the growth the more flavour and quality there is in the leaf.

The labourers in the plucking and manufacture of tea are recruited chiefly from among the Tamils in Southern India and Ceylon, and from among the Nagas in Assam. Women and children usually perform the plucking, and sometimes a woman can pluck fifty to sixty pounds of leaf in one day, earning about fifteen rupees a month.

After the flush has been weighed the leaves are dried or "withered" at the temperature of the atmosphere, on galvanised wire trays of about ¾-inch mesh, care being taken to prevent bruising or rubbing, as that tends to oxidise the leaves before rolling and this deteriorates the tea. This process occupies from eighteen to twenty-four hours, but sometimes it is hastened by fans being fitted to induce a draught.

The fans keep the withering-room fresh and sweet, and regulate the temperature, enabling a current of hot air to be admitted if required.

As the "withering" is evaporation of moisture from the leaf, the air is kept as dry as possible, circulating over and about the withering leaf so that the saturation point may not be reached in any one spot before another. To ensure this to perfection the leaf should be of the same plucking, otherwise a leaf wet with

morning dew will remain unwithered when one gathered in the heat of the day is ready for the next process.

Withering is the foundation of all that follows, and imperfect, improper or uneven withering will deteriorate the value of the out-turn. Under-withering not only results in a proportion of torn leaf in the roller, but a chemical change is set up by the under-development of the enzyme or oxidase, which later plays an important part in flavouring the tea and giving it an aroma.

Then the withered leaf is rolled through machines, so that all the juice in the leaves exudes. In ten or fifteen minutes the whole is worked into a pulpy mass.

Until recently most of the Chinese tea was rolled by hand, and there were stories of people suffering from fever being employed in the process.

Black teas undergo a further process. The rolled leaf is spread on the floors of the fermenting-rooms. The walls of these rooms are built with apertures between each brick. Wet cloths are hung outside the walls and the floors are of some glazed material—often of plate glass—which will not absorb moisture. The temperature of the rooms is between 78° and 82°, and the leaves take from three to four hours to ferment.

Then follows firing by machines, which pass a current of hot, dry air through the leaf until it is dry and brittle. The leaves then have a twisted appearance and will hang to each other some eight or nine inches long.

Next the tea is taken into the sorting-room and assorted or classified by machines of moving sieves of different-sized meshes. Orange Pekoe and other fine tea are whole leaf and should show the roll. The coarser tea is often transferred to breaking-machines and becomes broken tea, while the tea dust which accumulates during these processes is collected as "dust" or "fannings" and shipped separately.

Photographed by] [*Skeen & Co., Ceylon*

PLUCKING THE LEAVES FROM A TEA PLANT

A plucker with her basket nipping off the tip of the shoot, or two leaves and a bud.

The tea may now be fired again, but this is not always done. Then it is packed into lead-lined chests, stamped with the name of the garden or factory and transported to the quay if it is to be exported to foreign countries.

At one time the export of the leaf to Europe formed one of the most interesting romances in the history of tea.

Fast "clippers" or sailing-boats, built specially for speed, were dispatched from America and Britain to obtain tea and spices, and great was the competition of these vessels. Aberdeen was long celebrated as the home of this special form of shipbuilding. The American "clippers" of Baltimore were equally famous. One such boat, built in Boston in 1854, sailed at an average of fifteen and a half miles from China to Liverpool.

The clippers had to devise all sorts of ingenious methods to outstrip their rivals, and they were often obliged to fight pirates and privateers.

They sailed where no other ships dared to go, and anchored where no one else dreamed of looking for trade.

Directly the tea arrives in England it is taken to one of the London public bonded warehouses, where the chests are weighed by his Majesty's Customs officers, inspected, and stored. The merchants who own the shipments either sell privately or, more frequently, instruct brokers to sell at the Commercial Sales Rooms in Mincing Lane.

Wholesale buyers are notified by catalogues describing the different kinds of teas for sale. The buyers send their "samplers" or "tea-tasters" to test the different teas. Tasting samples are taken from the warehouse in numbered tin boxes, and, in order that the merchant should suffer no loss, the buyers or his

agents leave behind them a corresponding "return" of previous purchases of the same quality and quantity. That is why a grocer sometimes finds, on opening a retailed chest, a pound of tea wrapped in paper on the top of the package. The warehouseman can only judge of the "returns" by the leaf, but each packet has a distinctive mark, so that in case of a complaint from the ultimate buyer that the "return" is of inferior quality, the offender can be traced.

Tea-tasting is by no means so easy as it may seem. Sometimes there will be as many as 1200 different teas waiting for sale in about 50,000 packages. One "tea-taster" cannot, of course, try all these teas, but he will have to taste many, and it is said that many a "taster" has his digestion ruined after a few years. The performance, however, if we may call it so, is very interesting, and if we do not know how to make tea at home the lesson will be valuable.

First of all the teapot is warmed by boiling water, then half-a-spoonful of Indian or a spoonful of China tea is put in the pot. The water used is just at boiling point, not under, not over. The tea stands for five minutes, calculated by a sand-glass. Then it is poured out so that no leaf escapes. The scalded leaf is placed in the inverted lid, to be examined while you are drinking the tea, or waiting for it to cool, as it is difficult to detect the flavour if the tea be too hot. After a few trials you cannot fail to notice the distinct flavour of Darjeeling, the lightness of the Ceylon, the sappiness of the Sylhet, and the strength and heaviness of the Dooar, while among China teas the suggested flavour of peaches in the "Oolong," and the deep black colour of the "Paklin" will soon be readily distinguished. To value the different teas you taste is more difficult still, and requires long experience and judgment. Yet this

has to be done as quickly as the tea is tasted, and a figure entered in the catalogue indicating the limit of price which a buyer is prepared to pay.

Some buyers take no trouble to taste the teas, but value them "on the nose," to use the trade term. This is done by simply smelling and examining the leaf. There is, unfortunately, a prevailing tendency to do this, owing to the demand for cheap teas, which is penny-wise and pound-foolish on the part of the consumer, and induces the buyer to purchase "for price," or secure the lowest-priced tea he can, regardless of the special qualities. A large part of the public do not care about the particular constituents of a tea as long as it is cheap and pleases their palate; this has led to some of the best teas having a small sale.

The sales of Indian teas usually take place at Mincing Lane on Mondays, and, when necessary, Wednesdays; China teas on Wednesdays; Ceylons on Tuesdays and Javas on Thursdays. *Cherra* tea is not brought to public sale but sold privately.

The auctions are conducted with great rapidity, between two and three hundred lots being knocked down in an hour. The teas are sold at so much a pound, and the bids are increased by a farthing a pound. As may be imagined, the sale is, in consequence, very difficult to follow.

The teas being purchased, the buyer takes away his sample, and, later, receives the consignment, or takes it as he requires it for retail or blending purposes. As a rule the larger tea merchants blend the teas before they sell them to the retailer; but sometimes the retail grocer, if he possesses a good knowledge of tea, does this himself. In any case, from the time the chests are opened at the blending warehouse to the time when we buy our packet of tea, it is never touched by hand, the

varied operations in blending, weighing, packing and labelling being done by machinery.

It is not difficult to obtain a pass to admit one to the tea sales or to some place where tasting is being done; and we shall enjoy our tea all the more when we recall its romance, and remember that a pound of fine tea makes more cups than a pound of the coarser and cheaper commodity, besides being more refreshing.

CHAPTER IV

COFFEE

COFFEE is said to have been discovered by a pious hermit in Abyssinia who lived upon the milk of a few goats which he looked after with great care. One morning he noticed that a goat was unusually excited and self-elated. Watching the animal, he discovered that it grazed on some bright red berries of a handsome shrub among the hills. Tasting these himself, he experienced the same exhilaration. Thus was coffee discovered.

Introduced into Arabia by the Sheikh Dhabhani or Sheikh Abdallah of Aden in 1470, coffee found its way to Constantinople about 1554. A hundred years later coffee-houses, or cafés, had become such regular resorts in London and Paris that both the English and the French Governments restricted their use, and Charles II. in 1675 tried to suppress coffee-houses by Royal Proclamation, because "they were used to nourish sedition, spread lies and scandalise great men." Finding this unavailing, a heavy tax was imposed upon the commodity; but this only resulted in smuggling.

Strangely enough, coffee aroused quite as much antagonism in Arabia and Constantinople when introduced there. As it was used to dissipate sleepiness in the prolonged religious ceremonies of the Mohammedans, the most conservative and orthodox condemned it as an intoxicant and prohibited it. Nevertheless it became the most popular beverage of Arabia, and the celebrated Mocha, or Mokha, coffee is still exported

from Yemen in that country, although much of the commodity which comes into England under that name comes from India, some even from America.

Until 1690 the only source of coffee supply was Arabia. Then Governor-General Van Hoorne of the Dutch East Indies received some seeds from traders. He planted them at Batavia, in Java. So successful was the experiment that cultivation of coffee for commerce was started on a large scale. Thence the fame of the coffee plant spread to the West Indies and Brazil, and now it is grown in all parts of the tropics. At a more recent date the Liberian coffee plant was discovered in West Africa, and considerable commerce has ensued from the cultivation of that plant. Two other modern varieties are the Jamaica mountain coffee, and a hybrid, Coffee Robusta.

Coffee plants are propagated from seeds, for which the largest and finest fruits from selected trees are chosen. The seeds may be planted directly in the fields in the positions the future trees are to occupy, three or more being planted together so as to allow of the weaker plants being pulled up later. This method does away with the expense and risk of transplanting; but if the climate be not sufficiently moist there is always the possibility of drought injuring or killing the young seedlings. When raised in nurseries the seeds are sown in carefully prepared and thoroughly well-tilled nursery beds, situated so that the plants can readily be watered.

When the plants are about one to two feet high they are transplanted to their permanent situations, and shaded by coarse matting, palm leaves, etc., on a framework three or four feet above the ground, this being done at a season when showers are frequent.

Before transplanting the shade is gradually removed

and the plants hardened off. After being transplanted temporary shading is afforded by palm leaves and leafy branches. Ten to fifteen feet apart may be taken as about the average planting distance.

Catch crops are often cultivated between the rows whilst the coffee plants are young and small. Maize and beans planted between the young shrubs give a useful crop, and at the same time serve to shelter the coffee from the sun. Bananas and plantains are commonly employed in a similar way. As soon as the coffee plants become well developed and begin to bear fruit these other plants are removed. In those countries where there is no great difference in temperature at different seasons the coffee plant flowers all the year round; and very handsome does a coffee plantation look in full flower. The first crop of most coffee plants takes place in the second or third year, but a really fine yield is seldom made before the fourth or fifth year.

Coffee thrives to the best advantage in a hot, moist climate, and on rich, well-drained soil. A high rainfall is usually essential, and anything between 75 and 120 inches per annum, well distributed, is desirable. Coffee can be grown in dry regions and yield produce of excellent quality, but the crop is usually very small.

While its cultivation is confined to the tropics, coffee is pre-eminently a crop for fairly high elevations, and the best results are attained on estates situated above 2000 feet, although it will grow almost down to sea-level.

Although there are about eighty different species of the coffee plant, only a few are cultivated. Of these, Liberian coffee gives good results at lower elevations than the Arabian, from which the higher-priced "pea-berry" is picked. The Arabian plant or shrub can

attain a height of fifteen to eighteen feet, and each fruit contains two seeds, but it is rarely allowed to reach a height of more than six feet. The berries are picked when they are dark red and their skins shrivelled. Conveyed to the storehouse, they are pulped by two roughened cylinders moving in opposite directions and carrying the berries forward with a flow of water. After drying they are passed between two heavy rollers, which frees them from the husk. This shelled coffee is then sized through a tube perforated with holes of regularly increasing diameter, and the various sizes are hand-picked. The coffee is then ready for export.

The Liberian plant is distinguished from the Arabian by its greater height, which varies between eighteen and thirty-six feet, and also by the dimensions of its leaves, which sometimes attain the length of one foot. The flowers grow in clusters of six or eight together in the axils of the leaves, and exceed those of the Arabian plant. The pulp is less rich in sugar and tougher than that of Arabian coffee, which makes the use of special machines necessary in its preparation, and the flavour is not appreciated like that of the Arabian coffee.

The Jamaica blue mountain coffee plant is said to grow upon higher elevations and upon more stony and less rich soil than either the Arabian or the Liberian plant. *Caffea Stenophylla*, a native coffee plant of Sierra Leone, is also being experimented with. The flavour of this variety is said to be very delicious, and it is believed by some that it will be a formidable rival to the Liberian and even the Arabian coffee.

Coffee Robusta is indigenous to West Africa, and was discovered wild in the Congo region by Emil Laurent in 1898. The plant was named *Caffea Robusta* by a Brussels horticultural firm. A few plants were taken in Wardian cases to Java in 1900. In 1905 it first

By permission of] [*La Coloniale Revista*

DRYING COFFEE BEANS IN ANGOLA, PORTUGUESE WEST AFRICA

Natives are shown turning over the beans to let the heat of the sun get at them.

began to be planted there to a small extent; and considerable quantities were produced therefrom.

Robusta differs in many ways from the well-known Liberica. Firstly, it grows more rapidly. An eight months' old Robusta plant is much larger and has more branches and leaves than a twelve months' Liberica. Then the branches of Robusta are longer and have a tendency to bend down towards the ground, so that the bush is rather umbrella-shaped. Gourmandisers and suckers are also fewer; the leaves are a lighter green, thinner, and larger in size.

Further, Robusta bears more berries in a cluster than Liberica, sometimes over sixty; they are much smaller, but the beans are almost as large, as the skin is thinner. On an average ten piculs of Liberian berry give one picul of market coffee. Though many more berries go to a picul than in Liberica, the greater number in a bunch makes the picking as cheap, if not cheaper.

Plants about eight months old begin to show flower buds, but a number of these early flowers may not develop into berries, and no concern need be felt if they do not, as, unlike Liberica, all later flowers set.

The plant blossoms the whole year through, and no loss will occur from "windfall" if berries are collected once a month.

About ten months are required for the berries to come to maturity; when most of them in a cluster are straw-coloured they may be picked—as a rule the whole cluster may be gathered. A small crop can be collected in the second year, and in the fourth year practically the maximum crop is obtained. From that time onwards the yield is fairly uniform.

The cultivation of coffee is attended with many risks and much anxiety. In Ceylon and Southern India in particular, coffee plantations have been scourged by

rats, bugs, and fungus growths. The mysterious coffee-leaf disease played havoc with Ceylon coffee plantations in 1869, and with those in Mysore the following year.

It is not generally known that the leaves of the coffee plant contain caffeine—the substance in the seed which makes it so exhilarating—in larger proportions than the seeds themselves. In Sumatra the leaves are actually used, but being destitute of the aroma yielded by coffee and tea, the infusion is not palatable, and therefore not commerciable. For it is a strange thing that man drinks not that which is necessarily good for him, but what he likes.

England has never been a great coffee-drinking country, tea being the favourite afternoon beverage, but on the Continent coffee is greatly consumed, over 200,000,000 lbs. being annually exported to Europe.

Havre, Hamburg, Antwerp and Trieste are the principal European ports to which coffee is brought. Upon the arrival of the steamer the cargo is divided between a limited number of public bonded wharves or warehouses. If the coffee has been cleaned before exportation a sample, fixed by the Customs, according to the size of each package, is drawn from each bag, a weight taking the place of such coffee withdrawn. From a parcel not exceeding one hundred and fifty bags an eight-ounce sample per bag may be taken, six ounces only being allowed for larger parcels up to three hundred bags, and four ounces only for parcels of over three hundred bags. If the coffee be in barrels or cases, then one pound avoirdupois per package is permitted for parcels not exceeding ten barrels or cases, and twelve ounces if exceeding that number.

As this causes a deficiency in each bag before it is offered for sale, buyers have a draft allowance made

to them of sixteen ounces upon each bag between twenty-eight pounds and a hundredweight, and a corresponding allowance for larger quantities with a maximum of five pounds for all cases over five hundredweight.

The Brazil coffee is the only exception to this rule. Buyers of that kind have no such allowance, and must put up with any shortage. In London the coffee is sold by public auction in Mincing Lane, where samples are shown on small trays either on the day preceding the sale or on the morning of the sale. About five hundred lots are catalogued on one day, representing perhaps 500 tons. In valuing raw coffee colour is the first consideration, the deep blue, a light green, or a pale yellowy-green being preferred to grey or brown berries. The size of the berry is also a considerable factor. The bold or large berry fetches more than the small. The "pea-berry"—that is, the coffee bean which has come from a cherry or fruit which ought to have contained two, but, instead, contains only one, which has received double nourishment—is valued still higher.

The valuation of the roasted product by tasting is, however, a more decided but more prolonged test. No sample is more than the weight of a penny, and each must be roasted to the same degree. The coffee is ground direct into the cup and boiling water poured upon it until the cup be three parts full. Then the mixture is stirred thoroughly before the cup is filled to the top with boiling water. The frothing scum on the surface is removed and the coffee then settles at the bottom of the cup. In a few minutes' time it is cool enough to taste.

The process of roasting produces chemical changes in the coffee, renders it soluble in water and eliminates

a good proportion of its sugar. Upon the methods and duration of roasting depend largely the aroma and value of the coffee; but different nations have different tastes regarding the roasting. The French and Germans roast their coffee more highly than we do, and the Brazilians roast theirs more than any other people. In Brazil, however, whatever is roasted is consumed at once. Climate and the accommodation for storage largely determine, therefore, the degree of roasting. Roasting is usually performed over coke in a malleable revolving iron cylinder fitted with gauze ends to allow the liberated gas to escape. Hasty roasting chars the berries and spoils the flavour. Dilatory roasting also deteriorates the flavour. Directly the roast is complete the cylinder is drawn back and opened over a tray with a woven wire bottom, through which air is forced usually by a rotary fan. This cools the coffee rapidly and thus checks the development of the chemical changes.

While the physiological and dietetic value of coffee depends upon the alkaloid caffeine which it contains, its commercial value is determined by the aromatic oil caffeine which is developed in the coffee seed by roasting. This is performed in the country importing the product, and it is now found that by prolonged keeping or storing the richness of this oil is increased, and though loss in weight is incurred by storage, this is more than compensated by improvement in quality and enhancement of its value.

Finally, between the roasting of the coffee and its consumption there remains for consideration the "grinding." This seems so simple a matter as to call for no comment. Yet the best authorities assure us that fresh grinding is even more important than fresh roasting. The householder should therefore grind it

himself; and the coffee should not be ground coarsely, or the infusion will take longer to make and be less satisfactory.

Coffee has been proved to be of great value medicinally in spasmodic asthma, hysteria, malaria, colic, and dysentery, while for rheumatism and gout, a pint of hot and strong black coffee with a teaspoonful of black pepper has been found a wonderful remedy if taken before bed-time; and one or two physicians have stated that the vapour of hot coffee is beneficial to the eyes.

In each case, however, only pure coffee is remedial, and pure coffee is not always so easy to obtain. Many have been the Acts of Parliament against adulteration of coffee; but even now a few things are permissibly mixed with it. The most common mixture, and the only one allowed in England, is that of chicory; and some people prefer coffee with chicory to the pure coffee.

Chicory is prepared from the root of a weedy plant found wild in North Africa, North India, Siberia, and a large part of Europe, including Great Britain. At one time Yorkshire and Cornwall were centres for preparing chicory. Later, up to the period of the Great World War, Belgium was the largest exporter.

The presence of chicory may be detected by placing a small quantity of the coffee in a glass of water. Chicory softens and sinks, but coffee remains hard and floats.

CHAPTER V

COCOA

IN *The Public Advertiser* published in London on Tuesday, 16th June 1657, there appeared the following notice :—

"In Bishopgate Street, in Queen's Head Alley, at a Frenchman's house, is an excellent West India drink called chocolate to be sold, where you may have it ready at any time, and also unmade at reasonable rates."

The "reasonable rate," it may be mentioned, was 10s. to 15s. per lb.

Chocolate, both in its liquid and solid form, is, like cocoa, a preparation from the seeds of the cacao-tree, and much valued as a palatable and nutritious food. The above notice is the first intimation of the introduction of cocoa and chocolate into England. By the beginning of the eighteenth century it had become the fashionable beverage of the rich; and the cocoa-tree was a favourite sign and name for refreshment-houses. The "Cocoa Tree" indeed became first the headquarters of the Jacobite party, and afterwards the great Literary Club, including among its members Garrick and Byron.

Pope in his *Rape of the Lock* decrees that the negligent spirit

> "In fumes of burning chocolate shall glow,
> And tremble at the sea that froths below."

The celebrated "White's Club" of to-day was originally "White's Cocoa House," adjoining St James's Palace.

The beverage apparently became so popular that it was soon to be obtained of "an honest though poor man" in East Smithfield at 6s. 8d. per lb., or "the commoner sort at about half the price."

Later still, in the eighteenth century, appeared the following advertisement referring to a patented cocoa "now sold at 4s. 9d. per pound":—

"The curious may be supplied with this superfine chocolate that exceeds the finest sold by other makers, plain at 6s., with vanillos at 7s. To be sold for ready money only at Mr Churchman's Chocolate Warehouse at Mr John Young's in St Paul's Churchyard, London, A.D. 1732."

At this time also, cocoa was heavily taxed, the duty being collected by the sale of stamped wrappers for each pound, half-pound, or quarter-pound, as in the case of patent medicines. During the reign of George III. the excise duty on colonial cocoa was raised to 1s. 10d. per lb., while that on cocoa imported from a foreign country reached at one time the high figure of 5s. 10d. per lb., with an additional Customs duty of from 2½d. to 4¾d. on entry for home consumption. To-day cocoa is more popular than ever, Europe and the United States alone importing about 600,000,000 lbs. The export of cocoa to the Continent was prohibited by Great Britain during the World War.

But long before its consumption in Europe Montezuma, the Mexican Chief—or Emperor, as he is sometimes inaccurately called—had fifty jars or pitchers of this delectable drink for his own daily consumption, two thousand more being allowed for his household.

Bags of cocoa beans were also used in his empire as a means of exchange equally with pieces of tin or quills of gold dust. At royal banquets frothing chocolate was served in golden goblets, with finely wrought golden or tortoiseshell spoons. In Peru also, cocoa was highly prized, and Pizarro's followers, sailing along the Pacific coast, saw the hill-sides "checkered in the lower levels with blooming plantations of cacao."

Both the Aztecs and the Nicaraguans used cocoa beans instead of money as a means of exchange. The Aztecs also used cocoa mixed with the ground bones of their exhumed ancestors as a cure for dysentery. Columbus and the Jesuits appear to have introduced this commodity to the Old World, and Spain, which was the first European country to consume it, still uses more than any other country, in spite of the heat-giving qualities of the commodity.

From Peru, Mexico and the West Indies the cultivation of the cacao-tree has spread throughout the tropics, and in the Gold Coast and Portuguese West Africa in particular an increasing trade in the commodity is apparent. For many years the planting of cocoa was associated with slave labour, but through the efforts of the leading cocoa manufacturers, who are all Quakers, this has ceased.

The cacao-tree is a small tree or large shrub growing to a height of from twelve to twenty-five feet, and spreading out on each side to some ten feet. Three to six lateral branches are sent out at a height of a few feet from the ground, without any sign of a leading stem. Only when the branches are matured does a leader spring from the side. The leaves are large and undivided, the flowers clustered and small. Seldom does more than one of these flowers develop into fruit.

Photographed by] [*Skeen & Co., Ceylon*

PLUCKING COCOA PODS

The operation is a difficult one, as the fruit is extremely short-stalked, and the buds on its stalk must not be injured.

There are therefore many more flowers than fruit pods on the tree.

The fruit is yellow and red on the side next to the sun, the rind thick, the pulp sweet, the seeds numerous and covered with a thin brown skin or shell. These are the cocoa beans of commerce.

The plant has a long tap root, and likes rich, deep and well-drained soil, preferably loams or soil made by the decomposition of volcanic rocks, and such as is found in valleys and undulating country along river banks. Stiff loam clay soil is unsuitable for its cultivation. A warm, dry climate and an even temperature of 75° to 82° F. is desirable. Sheltered valleys with a southern or western aspect, from 200 to 500 feet above sea-level, near the seashore, but not exposed to the direct influence of the sea breeze—these are the best situations for cacao plantations.

Insects, grubs, monkeys, and deer are pests which attack cacao; if snakes abound, as they usually do, they should be preserved, as they attack animal pests.

The young cacao-tree is grown from seeds, perfectly ripe, kept for a week before planting. If kept long enough the seeds will spring themselves before the pod is opened. The seeds are planted in rows four inches apart with an interval of nine inches between the rows, the stringy centre of the pod planted downwards. When the seedlings are one foot high they can be planted out, an unbroken wall of earth being taken up with each seedling. Planting in bamboo pots rather than in the nursery is sometimes resorted to.

While the author was in West Africa he participated in the planting of cacao both on a modern plantation controlled by Europeans in Sierra Leone and on a wilder plantation maintained by a native chief, and was thus able to compare the two methods.

The native practice is, after felling the forest, to sow the seeds in small patches in roughly prepared beds close to water. Gaps are not filled, and two or three seeds are sown at one place, the weaklings being cut out during the second or third year. Even then the plants are too close together, and, as they are sown in irregular lines, some may be six feet by six feet, and others six feet by ten feet, whereas the wiser European planter gives them from twelve to fifteen feet. The excessive shade caused by close planting often prevents the fruit from forming so well, and favours rot through want of evaporation of moisture. On the other hand, the dense foliage makes weeding practically unnecessary.

The native cacao grower collects the pods from his trees at the time when he can gather the most, and in consequence many over-ripe and under-ripe fruits are taken with the ripe. This gives an irregular product, which can never possess the attributes of a good cocoa.

The pods are usually pulled off the tree, a knife being seldom used; and, in the action of pulling off, the cushion, upon which the pod is borne, is often torn and injured. As it is from this point, or near it, that the successive crops of flowers and fruits proceed, the bearing power of the tree is thus frequently diminished.

The pods after collection are thrown into a heap upon the ground, and are often left without further attention for two or three days, after which they are broken open with the aid of a "cutlass," and the contents scooped into a basket. This medley of pods and pulp is then washed and sun-dried.

The European planter is more careful. He knows that young cacao-trees require shade and will not thrive without it; even when fully grown they give

Photographed by] [*Skeen & Co., Ceylon*

GATHERING THE COCOA CROP

The fruits are afterwards split and the nibs or beans torn out by hand.

better returns when shaded by large trees planted at intervals.

For this purpose of shading the banana-tree serves well, and gives a profitable return while the cacao-tree is growing. For permanent shade, rubber, bread-fruit or other trees are suitable. In exposed situations, hedges or wind-breaks of some kind are necessary. Manure, except for delicate and sickly plants, or where the soil is poor or lacking in necessary chemical constituents, is not actually necessary until after the first crops have been taken, though a moderate application will often facilitate growth and effect heavier and earlier production. Regular manuring is carried out as soon as the crop-taking has commenced, if permanent and improving crops are to be expected.

Cacao produces when four years old. From the seventh to tenth year it arrives at full maturity. The cacao-tree bears nearly all the year round after about four or five years old, with an average crop of from 1 to 7 lbs. per tree, and as much as 4 cwts. per acre.

The first flowers are not allowed to produce pods, as this exhausts the tree. The pods are not picked until fully ripe, and must be cut cleanly from the tree, close to the stem, with a cacao knife or cutlass—*not torn off*—or the next batch of flowers will fail. The pods sound hollow when tapped by the knuckles.

After the pods have been opened and the beans shaken out—usually done by women—they are piled in heaps or in clay-walled holes and covered with sand and plantain or banana leaves, or placed in tubs in a sweating-house and similarly covered. There they are allowed to ferment. The beans are turned over daily for two or four or even as much as ten days during this "sweating" or fermentation process. The object

of sweating is to remove the sticky mucilage which comes from the bean.

The beans are now laid out in trays or mats in the sun and constantly raked over during twenty-four hours. This is termed "partly curing." They are then sprinkled with a little moisture, placed in a tin or iron vessel and polished by natives treading upon them or, in more modern plantations, by a polishing machine.

Next they are laid out in trays in the sun for four or five days, until the beans crackle on being pinched. Then, by some planters, they are damped to receive a sprinkling of finely powdered red earth, in which case they are spread out once more in the sun until they are dry, and thence bagged ready for shipment in sacks generally containing 100 lbs., 168 lbs. or 205 lbs. There is usually a loss of 1½ per cent. in weight by the time of arrival in England.

The airing or sun-drying trays are generally long platforms fitted with wheels and laid on rails, enabling them to be easily wheeled in or out of the sheds for protection in bad weather and during the night. Some plantations have fixed trays and movable roofs. Another plan is to dry by artificial heat in closed chambers, hot air being drawn over the beans; but the results are not so good as when naturally dried in the sun. The natives frequently do not dry the beans sufficiently on their own estates, in which case the firm which buys them for export gives them the final drying.

A cacao plantation is a beautiful sight.

At morn when a bugle sounds the mist still clings to the valley, and if it be harvest-time the men will carry long bamboo poles capped by a band of steel for cutting the pods. The women sit near a running stream with trays formed of broad banana leaves, into which are placed the beans extracted from the pod by

wooden spoons. Between the harvests pruning and cleaning the land is performed, most of it in pleasant shade. Ten hours a day is the average labourer's work.

In preparing cocoa beans for the market the beans and adherent pulp, after being removed from the fresh pod, are placed in a vat or other receptacle, where micro-organisms bring about fermentation, the temperature of the mass rising from 30° to 50° C. The germ of the bean is killed in this process, and at the same time the astringent matters in the fresh bean are destroyed to a great extent, and the colour changes from a purplish hue to a rich brown. The chief object of this process is to kill the bean without injuring the oxidising enzymes, This is stated to be the best means of reducing the bitterness and altering the colour. For this reason the beans are frequently turned, to keep the temperature below 60° C. In some of the chief cocoa-producing countries it has been mentioned that the beans, after having undergone the process of fermentation, are dusted over with finely powdered red clay. The clay adheres to the shell of the bean, which is still moist and sticky, and then the beans are polished. This "claying" has the effect of improving the appearance of the beans, and is also stated to assist in preserving them against fungoid attack.

This practice, however, degenerates into a mere "weighting" of the cocoa, and therefore it is not encouraged, unless it has distinct advantages in enabling planters to put their cocoa on the market in better condition.

Now brokers and manufacturers do not favour the claying of cocoa beans. It is, of course, possible that claying may to some extent prevent the formation of mould, since the clay will absorb and assist in

dissipating traces of moisture on which mould might develop; but the best method of avoiding mouldiness is to dry the beans thoroughly after fermentation, or after washing, if this last process is employed. If necessary, artificial driers are used in order to ensure that the beans are thoroughly dried before export.

The birth and growth of the cacao industry in the Gold Coast reads like romance. Tottah Quarshia, of Christianburg, towards the end of the nineteenth century brought a few beans from Fernando Po, where he had been working as a blacksmith. Planting them and nursing the seeds, his little enterprise soon became profitable, and others imitated him. In 1891 the first shipment of about 80 lbs., valued at £4, was made to this country, since when it has leaped rapidly to about 80,000 tons, valued at about £4,000,000 sterling—more than a third of the total cacao production of the world. Every pound has been grown by native farmers, and the family incomes of cacao growers have been multiplied a hundredfold or more, many amounting to between £1000 and £2000 sterling yearly, a few being even larger. Cacao is now also being grown in Togoland, Liberia, Cameroons, Sierra Leone and Nigeria.

The cocoa beans are exported in bags containing from one to one and a half hundredweight. In London they are offered at a special sale held weekly in the Commercial Sales Rooms in Mincing Lane.

Upon arriving at the factory of the cocoa manufacturer the beans are sifted by a sorting and winnowing machine which, by separate shoots, throws out the cleaned beans, graded according to size, and the dust and foreign matter.

Then the beans are roasted by high-pressure steam and passed through a cooling chamber for "breaking down." The latter operation consists in cracking the

Drying Cocoa Beans on Messrs. Cadbury's Estates

bean shells and releasing the "nibs" or kernels by a machine which winnows the shells and dust by a powerful blast. Some of the shells are sent to Ireland, where they are used by the peasants and called "miserables." The "nibs" are sorted and ground between horizontal millstones, the friction and heat ensuing melting the butter contained in the nibs until the whole mass is turned into a treacly solution, which is poured into round metal pots lined with felt pads. These are placed under a hydraulic press to extract the greater percentage of natural oil or butter. The resulting dry cake is ground to flour to form the cocoa essence which we buy and use.

Chocolate is specially prepared from the finer cacao seeds by first roasting, then shelling or depriving the shells of their husks, when they are ground up to a paste on hot plates, and sugar, vanilla or cinnamon, and sometimes arrowroot or rice flour is added. Arrowroot, starch, gratings of kola shells and other adulterants are frequently added to cocoa by the less reputable manufacturers.

In the New World one or two varieties of drinks are made from cocoa mixed with other substances, but the commercial value of the article lies in the cocoa itself. One of the few natural products which can at the same time serve equally well as food or drink, it was rightly named by Linnæus "the food of the gods," and so great is the recognition of its nourishing and stimulating qualities that the British Navy serves it out daily, and the British Army several times a week.

In Southern Nigeria cacao growing has been, during recent years, encouraged by the Government, with marked success and increasing production. In this region cacao-trees begin to bear fruit when three or four years of age, and yield about half-a-pound of cured

cocoa per tree. The yield increases annually, until at six years of age a tree may produce from two to four pounds, and in good soil as much as five to six pounds. Cocoa is, therefore, worth more attention from planters.

In Nigeria the exports of cocoa have increased from 99,000 cwts., valued at £172,000, in 1914, to over 200,000 cwts., valued at about £400,000. Ibadan is the largest producing centre, and three native cocoa instructors are employed in the Calabar and Abeokuta provinces and in the Agege district. In the first-named, cacao planting competitions are encouraged by the Government. In the second, the Government undertook a great experiment in plantation sanitation.

Excellent plantations are to be found in Togoland and the Cameroons. Those in the latter country have been cleared and cleaned under the direction of Mr Evans, formerly of the Department of Agriculture in Trinidad. The last crop totalled 30,000 bags. Cacao there is grown on estates averaging 1000 to 2500 acres, thus contrasting with the small individual holdings of the Gold Coast proprietors. The plantations are also well equipped with artificial drying-houses, and staffed by Europeans, the type of cacao favoured there being "forastero."

Sierra Leone has also become a cacao-growing country since the author of this book discovered and drew attention to the numerous little native cacao plantations hidden in the bush from the Government, because of fear of further taxation.

In Liberia the planting of cacao on native farms has been made compulsory by the Government.

In 1918 the U.S.A. Government put an embargo on all West African cocoa, but owing to the efforts of the British West African Association, which called a conference and interviewed the Embassy, it was removed.

CHAPTER VI

SUGAR

SUGAR is a name given to a large number of sweet substances extracted from the animal and vegetable kingdom or produced from glucosides by the action of ferments or dilute acids. These substances are usually grouped into two classes, unfermentable sugars—such as mannite, dulcite and sorbite—and fermentable sugars, like saccharose or cane sugar, glucose and maltose. Of these the principal sugar of commerce is saccharose, called also sucrose, canose and cane sugar. This is found in the juice of many grasses, in the sap of several trees and in the roots of beets and other plants. Walnuts, almonds and St John's bread contain cane sugar, but the commercial product is extracted easiest and principally from three sources: the sugar-cane, the beetroot and the sugar-maple tree.

The sugar-cane is a strong, cane-stemmed grass growing to eight or twelve feet high, with a feathery plume of flowers, in India, China, Java, the South Sea Islands, Japan, Egypt, Queensland, West and South Africa, the West Indies, Guiana, Brazil and other parts of South America. Among natives it is chewed, sucked, boiled and generally forms a universal article of subsistence.

Its original home is believed to have been India, Malaya or Cochin China. About 325 B.C. Nearchus, a Greek admiral, found it growing in the East, and his master, Alexander the Great, is recorded to have feasted on "solid honey not made by bees." The Greek

physicians appear to have called it "Indian salt," and it is mentioned in Lucan's *Pharsalia.* The Jews also appear to have known of it, and Jeremiah probably alluded to it when he wrote of "a sweet cane from a far country."

The Arabs introduced the sugar-cane into Egypt, Sicily, Spain, Rhodes, Cyprus and Crete. The Crusaders, finding it growing in Syria, introduced some sugar into England during the twelfth century, but until the reign of Henry VIII. it was little used, and even then only by the wealthy. Eightpence a pound was the price paid for it in the sixteenth century, when a penny was worth about sevenpence.

Don Henry of Portugal introduced the sugar-cane into Madeira and the Canary Islands in the fifteenth century. The Spaniards grew it in the south of Spain, and it is still grown there, though not on a large scale. They also introduced it into the New World in the sixteenth century and made its cultivation so successful in Haiti that the cost of the great palaces at Madrid and Toledo were defrayed by the port duties imposed there upon sugar. Cuba and Java are now the largest producers of cane sugar, over 1,000,000 tons being exported annually from each country.

The sugar-cane generally requires a temperature of 80° and an annual rainfall of sixty inches. Like the common bamboo, it has a hollow, pointed stem divided into sections, a leaf originating at each node, the sweetening principle being contained in the pith. The plant is perennial and grows in a cluster, throwing up additional stems from the buds or from its lower nodes below the surface of the ground.

As the roots are fibrous and do not penetrate the ground to a great depth, a number of canes spring up from underground suckers. The plant is produced

from the eyes or buds which grow on the stems. No cultivated cane ripens its seeds, and the best planters always lay down fresh canes after two or three years, and in some cases every year.

The cane is planted in rows about three feet apart, with two feet between each plant. It flourishes in clays, loams and calcareous soils, thriving best in a warm, moist climate, with sea breezes and moderate intervals of hot, dry weather. In India the land chosen for its cultivation is a good loam or light clay well manured. The leafy ends of the canes of the preceding season are cut off, or the whole cane is cut up, each piece containing two nodes or joints. Twenty thousand of these are planted on each acre in January and February. The harvest begins early in December, and the cutting and crushing of the canes will continue until January or February. Hand labour is usually employed.

Twenty to thirty tons per acre is a crop. This yields fifteen to twenty-five tons of juice, but this evaporates to about one to one and three quarter tons of sugar. Small mills having only three rollers extract only about half the total juice; large and powerful mills extract 75 per cent. of the weight of the cane as juice. A ton of stripped cane yields about 150 lbs. of sugar. When the skin becomes dry, smooth and brittle, when the cane becomes heavy and the pith grey, or approaching to brown, the juice should be sweet and glutinous. The cane is then cut down and, generally, crushed between rollers to remove the juice. The latter operation is sometimes preceded by immersion of the canes in water. Sometimes the canes are cut into short lengths and soaked in an equal weight of water, the resultant liquor being passed from one vessel to another. The sugar juice, on coming from the crushing rollers and

neutralised with milk of lime is called "clarified cane juice." To prevent fermentation it is treated with sulphur dioxide.

It is then heated to 80° C. (176° F.), skimmed and evaporated by mechanical evaporators, consisting of steam-pipes, which are alternately dipped into the juice and exposed to the air. The uncrystallisable syrup remaining is removed by draining or by centrifugal machines, or sold for export without further treatment.

The juice is now run through cotton bags, charcoal or capillary fillers, the "char" decolorising it.

The purified resultant is then boiled down in steam-heated vacuum pans at a temperature of 82° (179° F.), more syrup being added as crystallisation sets in. When sufficient crystals have been formed, the crystals and syrup—or massecuite, as it is then called—is carried off into a centrifugal machine, which separates the syrup from the crystals, which are washed by a water spray, spread out to dry and packed. This process is repeated with the drained-off syrup and the final residue converted into "golden syrup."

Cube sugar is made by running the massecuite into moulds, washing out the syrup with pure sugar liquor, drying, and finally cutting into cubes.

The old-fashioned brown or moist sugar is made by evaporating the syrup in open boiling pans, granulating in cooling tanks and "curing" by allowing the molasses to drain away from the massecuite placed in perforated hogsheads or bags. Barbados still make this sugar, as well as various white and yellow crystal sugars, their total export reaching about 60,000 tons and about the same number of puncheons (each 100 gallons) of molasses.

Molasses or treacle is obtained in the refining of sugar, and consists usually of 20 per cent. water, 36

per cent. crystallisable sugar, 36 per cent. inverted sugar, 5 per cent. organic acids and extractine, and 3 per cent. mineral matter.

Cane sugar ($C_{12}H_{12}O_{11}$) dissolves in one-third part of cold water. Its crystals have a specific gravity of 1·6. It melts at 160° C., then solidifying into "barley sugar," and at a higher temperature is converted into a dark brown substance known as "caramel."

Rum is produced from sugar by the rapid fermentation for three or four days of a wash consisting of scummings from the sugar-pans, scummings and molasses mixed, or molasses diluted with water, till the "sett" or mash is of the strength of about 12 per cent. of sugar.

The more the scummings the finer the rum.

The wash set up is slightly acid. Often sulphate of ammonia in small quantities is added to provide nitrogenous food for the yeast. Every ten gallons yield one gallon of rum. Pine-apples or guavas are occasionally added for flavouring. Its strength, as imported, is usually reduced before passing into the hands of the consumer, and when the retail customers are Africans or Asiatics in distant plantations or native lands there takes place a further and more extensive dilution.

Another by-product in commercial demand is molascuit, a cattle food prepared from molasses and the crushed fibre of the sugar-cane.

Even these varied products do not exhaust the usefulness of the sugar-cane. Megasse or sugar-cane refuse is converted into paper. The megasse is mingled with banana leaves and stems, bamboo and Pará or similar grass. For every ton of sugar produced there is a ton of this fibrous refuse, and each ton of refuse yields between $\frac{3}{5}$ths and $\frac{4}{5}$ths of a ton of pulp, worth about £12 per ton.

In many of our West Indian colonies, such as British

Guiana, Barbados, Antigua and St Kitts-Nevis, sugar, with its by-products, forms the main industry, constituting, indeed, nearly 50 per cent. of the combined agricultural and mineral productions exported from the West Indies.

Naturally, therefore, our colonists have been inclined to view with apprehension, or at any rate with little sympathy, any attempts to obtain sugar from other sources than the cane. Nevertheless such attempts have been made, and not without success.

The most formidable rival of the sugar-cane is the beet.

Beet sugar now comprises nearly one half of the world's commercial sugar crop. The sugar beet from which it is extracted is a variety of the wild beet, like the mangold wurzel, and the red beet which we place on our table. The sugar beet, however, has a white root. Now, both the white and the red beet were cultivated long before the Christian era. Yet the presence of sugar in the beetroot was not noticed until 1590, when Oliver des Serres discovered it in the red beetroot. Its extraction was not suggested until 1747, when a German urged the Berlin Academy to cultivate the beet for this purpose. Even then the suggestion was not adopted, and it was left to a French refugee named Achard to make the experiment and describe it to the Institute of France. Although both he and a German continued the experiment, they were generally ridiculed, until Napoleon, in order to shut out British goods, gave practical assistance and ordered 80,000 acres of sugar beets to be cultivated in the French Empire, which then included part of Germany conquered by that Emperor. In spite of caricatures showing Napoleon and his son with a beetroot, and the words, "Suck, please, suck, your father says it's sugar," the conqueror persisted,

and although, with his fall, the industry collapsed temporarily, it was taken up again, and to-day in the north of France, in Germany, Belgium and Holland it is of great commercial importance, while in England the London and South Western Railway is encouraging sugar-beet culture in Surrey, Hants, Wilts, Dorset, Somerset, Devon and Cornwall.

The sowing of the beet takes place in March. After the processes of weeding and thinning out there is a distance of from seven to ten inches between the plants. Care is taken to cover any part of the root obtruding above the ground, as the influence of daylight is prejudicial to the development of sugar in the roots. The larger the roots thus preserved the greater the amount of sugar. It is not often practicable, however, to wait for the roots to acquire the maximum amount of sugar possible, as harvesting has to consider the weather and the requirements of the sugar industry. Consequently the harvest takes place between September and the end of November.

Before storing, the leaves are cut from the roots, otherwise the sugar in the roots would be exhausted. Very ingenious machines are now used, which pull out the plants, cut off the leaves and drop the roots upon one side, ready for removal. In the factory the roots are first vigorously cleaned by machinery, then cut, by another machine, into small rectangular pieces or thin slices. These portions fall into diffusing pans. Water is poured into the first of these pans, heated by steam. Part of the sugar is thereby dissolved. This water flows on to the second pan, in which are fresh pieces of beetroot, consequently containing more sugar than those in the first pan, from which some was extracted. In this way the liquid flows on to successive pans, becoming sweeter as it goes along. After the pulp has

been discharged the first pan becomes the last, each diffusing pan in turn becoming first and last. This process extracts about 97 per cent. of the sugar. The beet juice, like the sugar-cane juice, contains some solid impurities, which are removed by filtering, and some which have to be rendered insoluble by chemical methods. The beet juice has a higher percentage of impurities, and these cannot be used, like cane molasses, for confectionery purposes because of their unpleasantness. They are therefore fermented and distilled to supply alcohol.

The subsequent processes of extracting sugar from the beet are similar to those used upon the cane.

That sugar can be extracted from other sources than the sugar cane and beet is not generally known. Yet for many years before the Southern States of America and the West Indies exported cane sugar to the northern parts of America maple sugar was used by the white people of these parts as their chief sweetening material, while for centuries previously the Red Indians had used the same commodity. Even to-day, although the competition of beet and cane sugar has supplanted the use of maple sugar by the masses, it is still in demand by the wealthier classes because of its peculiar flavour, which is especially appreciated in the form of candy. This demand has rendered it an article of luxury and saleable at a higher price than that of cane sugar.

The American maple-trees from which this sugar is extracted are closely related to the British maple. There are several varieties, of which only the "Sugar," "Black," "Silver," "Red" and "Oregon" species yield sugar. The "Sugar-Maple" and "Black" varieties, which give the best sugar, are found in the damper soils from Quebec to Arkansas, while the

By permission of] [*Queensland Government*

SUGAR CANE IN QUEENSLAND

In former years the cultivation of the plantations was carried on by Kanaka labour imported from the South Sea Islands, but this has now ceased.

"Silver" maple is found from New Brunswick to Florida, reaching its greatest perfection on the banks of the Ohio and Mississippi.

From the American Indians the first white settlers learnt how to extract the sugar sap from the maple. A slanting cut was made in the trunk with an axe, a reed being inserted in the lower end of the cut to convey the running sap into a collecting receptacle. Then the sap was boiled in the woods. By this primitive method, of course, portions of bark and leaves, besides other impurities, were frequently found and boiled in the sap. To-day an auger hole is bored in the tree instead of hacking with an axe, and a closed metal spout takes the place of the reed, while the boiling process is performed more carefully, so that the aromatic bodies which give the agreeable flavour are retained after the sap has been boiled, while the less desirable constituents escape during the process.

Saccharin was discovered by accident in 1887.

Dr Fahlberg was studying the chemistry of coal-tar at the Johns Hopkins University in America. While having a hasty tea one evening, without changing his clothes, he detected a sweet flavour upon his bread and butter. Tracing this sweetness to his fingers, his hands and his coat-sleeves, it occurred to him that it must have come from one of the compounds with which he had that day been experimenting. Returning to his laboratory, he tasted each vessel he had used until he came to the particular compound which he named orthosulphaminebenzoic acid. It was then discovered that it could be prepared by oxidising orthotoluene with potassium permanganate, that its sweetness was about three hundred times that of sugar, and that, forming white crystals, soluble in hot water, alcohol and ether, it melts at 220° with partial decomposition,

and when taken into the human system passes through unchanged.

Naturally, its medical usefulness—particularly for those people who are forbidden by their doctors to take sugar foods—as well as its commercial possibilities were at once recognised. France and Germany seized upon it as a rival to beet sugar, and commerce in this commodity became so threatening that the powerful sugar manufacturers have, since its introduction, enforced in most countries its recognition as a drug and consequently restricted its sale excepting through chemists.

The latest discovery concerning sugar is that it can be manufactured from sawdust.

In its natural state wood contains no sugar, but when sawdust has been subjected in closed retorts to digestion with a weak sulphurous acid solution under pressure of six to seven atmospheres a very remarkable transmutation takes place, as much as 25 per cent. of the material being converted into sugar.

Fortunately the people who have invented this do not suggest that it should be used for human consumption, but as a food for horses, cattle and sheep.

Sugar was one of the first commodities controlled by the British Government during the Great World War, and in the Port of London Authority's warehouses at one time there was stocked between 80,000 and 100,000 tons. Sugar as a rule is bought on c.i.f. terms and payment is made against documents when the sugar has arrived in the ports of the country. When war breaks out the only way in which sugar can be bought is by placing the money at the port of loading. As a big refiner may use about 4000 tons a week, and might have about twelve cargoes on the way, amounting perhaps to nearly £1,000,000, he would find it difficult to obtain

such a sum from any bank, and had not the Government stepped in during the World War the United Kingdom refiners would have been in a very bad position. But the Government had other reasons for control. Wholesale prices had trebled within the first week of the war, because Germany and Austria had for a number of years supplied us with almost two-thirds of our sugar requirements, and the retail consumer was threatened seriously.

The Government therefore made an arrangement for the whole body of refiners to stand aside from the market for raw sugars, leaving it free for the operations of the Government, which immediately secured all available sugar in America, Cuba, Java and our own sugar-producing colonies. Incidentally, of course, this was a triumph for cane over beet sugar. As *The Times* records:

"They bought about 900,000 tons, not only of sugars for refining purposes, but also of white sugar for manufacturing purposes and direct consumption. Had not the Government secured all the above quantity when they did, there would have been a period between then and now during which it would have been difficult to secure sufficient sugar except from enemy countries or from countries to which grave suspicion attached.

"The Government, having secured the necessary supplies, then formed a Royal Commission to arrange the price at which the raw sugar was to be sold to the refiners, and also regulate the price at which the refined article was to be sold to the trade."

By this action the British Government saved their consumers millions of pounds, besides making a large sum from the transactions in order to relieve taxation. They also prohibited the import of any other sugar of

any kind. This also was necessary. To quote again *The Times*:

"It would have been impossible to prevent sugar from Germany and Austria from reaching the United Kingdom through neutral European countries, and, at the same time, preventing money as payments reaching the enemy countries. The same applies to the prohibition of imports from America. Previously, thousands of tons of American granulated sugar were sold in this market, and there was a strong inducement to the American refiners to increase such sales and import German and Austrian beet from neutral countries at a price far below that of Cuban sugar."

CHAPTER VII

CONDIMENTS AND SPICES

THE commerce of man is not confined to foodstuffs of nutritive value.

From the earliest times man has sought to beautify his needful clothing and to render palatable, savoury and spicy his normal food. The substances used for the latter purpose are known as condiments and spices. Although probably first used merely to flavour food, it was soon discovered that most of them also served more useful purposes—namely, as aids to digestion and other medicinal utility.

Take, for example, our common condiments—salt, mustard, pepper.

The evaporation of salt from salt water was known to many an ancient people, and valued very highly. The expressions, "Ye are the salt of the earth," and "to be worthy of one's salt," speak for themselves. Not so long ago also it was customary for the family salt-cellar—generally composed of massive silver—to be placed in the middle of the table to indicate the status of the guests. Those of distinction sat "above the salt"—that is, between it and the head of the table; while dependents or guests of lower caste sat "below the salt."

Not to take salt with another person was once considered by many people to be a demonstration of bitterest enmity; and to spill salt is still by many people considered unlucky.

About the middle of the fifth century a gallant band

of refugees, inhabitants of the Roman districts of Padua and Aquila, flying from the outrages of the Huns, settled upon some barren islands among the lagoons at the head of the Adriatic. By the evaporation of salt and the sale of this product and fish to the people of the mainland these people laid the foundation of one of the greatest republics of the Middle Ages, and built a city which is still a marvel and a curiosity to the world, and was for centuries the greatest centre of commerce in Europe. This is but one of the many parts which salt has played in the romance of commerce.

Long before the building of Venice or the invasion of the Huns the art of making salt was known to the Gauls and Romans. The extensive rock-salt beds of Northwich, in Cheshire, were known to the Romans and have been worked for many centuries. The salt there is cut from the bed in masses of five to eight feet in diameter, and then crushed with rollers. Afterwards it is dissolved in salt water, evaporated and crystallised.

The rock-salt mines at Wielitzka, near Krakow, have been worked since A.D. 1251, and form one of the most curious and interesting sights in Europe. Extensive subterraneous excavations have been made, the roof being supported by pillars of salt, while different parts of the mine are cut into the form of churches, chapels and other buildings. The salt is impure, being mixed with clay. It is purified by dissolving it in water, and then evaporating it.

Salt is not only found by the sea or in inland mines. Much of the salt used in or exported from Britain is derived from salt springs. These are abundant in Cheshire, Lancashire and Worcestershire. Those of Barton, in Lancashire, and Droitwich, in Worcestershire, are exceptionally rich. They rise through strata of sandstone and marl which contain beds of rock-salt.

Culinary salt is obtained from them purely by evaporation. Besides being used for seasoning and preserving food, it is employed in the manufacture of muriatic acid and soda, to harden soap, to glaze pottery, to preserve timber and many other purposes. From the time of the Romans upwards salt has been very heavily taxed. From 1798 to 1825 it was taxed in England, and until a later date the Port of London had the right to a 5 per cent. tax on all salt coming to London. In India the tax amounts to-day to 5s. 5d. per cwt.

The story of mustard is equally interesting. Who has not read the Biblical parable in which heaven is likened unto a grain of mustard seed ?

But how few of those who read the parable stop to consider that the mustard plant as grown in England to-day does not reach the size of a tree as mentioned in the Bible, or even that of a shrub.

Fewer still are they who are aware of the controversy which has raged over the question as to whether Christ referred to the common black mustard-tree which is indigenous to Palestine and grows to a height of ten to fifteen feet, or to the *Salvadora Persica*—also common to Palestine—which bears the same Arabic name as that for mustard.

Yet this is but one of the many interesting incidents in the romance of mustard.

The story of this common commodity of commerce begins many hundred years before Christ. Pythagoras, one of the wisest of Greek philosophers, who lived more than five hundred years before Christ, mentions mustard; and Hippocrates, the famous physician of the island of Cos, used it as a medicine between 430 B.C. and 400 B.C.

The Romans discovered that after a cold bath mustard with olive oil made an excellent embrocation,

while pounded and mixed with vinegar it would counteract fungus poisoning and cure serpent stings.

The Romans used mustard also in other ways than medicine. They fermented the seed in a fiery but inferior spirit like bad brandy, calling it *mustum ardens*, which means burning wine. Some authorities believe that the derivation of our word "mustard" is to be found in this connection.

Certain it is that at least three kinds of mustard were grown and much prized by the Romans, for they are mentioned by Pliny the Elder, the great Roman naturalist, in his *Historia Naturalis*, written in A.D. 77. In the same book it is remarked that although the seeds had been imported originally from Egypt, the mustard plant was growing in Italy "without being planted," or, as we should say, it grew wild.

In mediæval Europe it was in general use and distribution by the monasteries, the feudal nobles and their dependents. When it was first introduced into England is not known, but the Household Book of the Earl of Northumberland in the fifteenth century records that one hundred and sixty gallons of mustard seed were supplied yearly to his lordship's servants and retainers. Shakespeare mentions it in *As You Like It* and *The Taming of the Shrew*.

But mustard in those days, you will notice, is always referred to as "seed," not "powder," as we know it. The reason is because the seeds were then brought to table in their original state, and were crushed upon the plates after vinegar and water had been added according to one's taste. Tewkesbury was then the mustard-growing district of England.

The idea of grinding up mustard seed and preparing it before selling it for table use first occurred to a Mrs Clements of Durham in 1720; and she made a fortune

by her invention. King George I. gave her his patronage and her "Durham Mustard" became almost as famous as Colman's mustard is to-day.

Twice a year she travelled to London to book her orders personally, and to the day of her death she kept secret the special process by which she manufactured her mustard.

After the death of Mrs Clements the industry moved to the Fen District of England. And it is there to-day that large fields of the mustard plant are cultivated with special care to supply the huge demand for this popular table condiment.

There are three kinds of mustard plants, as in Pliny's day, besides the wild *Sinapis Arvenis*, commonly called charlock. The white mustard is commonly planted in gardens for eating with cress, or forming part of a salad, or for medicinal purposes, the seed yielding a yellow and almost inodorous oil. This plant will grow on comparatively poor soil. The black mustard, on the other hand, requires a rich soil and careful cultivation. It is from the seeds of this plant that the best mustard is principally made, although some mustard makers when crushing white and black seeds together use a larger proportion of white, while others make an inferior product from the seeds of the *Brassica Juncea*, which is a third kind of mustard plant grown chiefly in Russia and the East Indies.

About March or April the seeds are sown, sometimes broadcast, after the ground has been ploughed and harrowed, sometimes in drills six to twelve inches apart. When two or three inches high the plants are thinned out. Quickly running up to stalks, they flower brilliantly, and afterwards return a crop of seed by August or September. The seed is gathered when ripe in sacks and sent to the various markets, the principal one

in England being at Wisbech, in Cambridgeshire, where it is sold to the buyers of the great manufacturers, who keep secret their various processes of manufacture.

Black mustard flower contains two chemical substances called sinigrin and myrosin, which when placed in cold water react upon each other and liberate an oil within ten minutes. Boiling water prevents and warm water checks this reaction.

The ordinary table uses of mustard are well known. Its efficacy as a plaster for a cold, or in a bath for sleeplessness, or as an emetic in cases of poisoning is unquestionable. But mustard has many uses which are less common knowledge. A pinch of mustard in a wine-glass of water stops hiccup. Mixed with milk and curdled, it relieves and often cures dropsy, bronchitis and rheumatism. Applied externally, it stimulates the nerves, skin and blood-vessels.

Another common condiment which has played a romantic part in commerce is pepper.

There are several kinds of peppers, each coming from a different tropical plant. What is called "cayenne" pepper, for example, comes from the capsicum, the dried fruit of which is known in West Africa as "chillies." This scarlet fruit is used for pickling, but when ground in a mill produces "cayenne."

The pepper most familiar to us, black or white pepper, comes from a perennial climbing shrub found in Java, Borneo, Sumatra, Southern India, the West Indies and almost everywhere in the tropics, and is usually named after the locality from which it is imported.

The young vines are planted beside mango, yak or similar trees, which afford them shade and yield the necessary support for the climbers. When two or three years old the vines flower, bearing spikes of red berries. These are carefully hand-picked before they are quite

ripe, the natives separating the stalk by rubbing with their hands and feet. The berries, laid out to dry, soon become black and shrivelled. Then they are ready for market as "black" pepper. If, however, "white" pepper be required, the berries are allowed to become riper before being gathered. Further, they are soaked in water, and their outer skins rubbed off by hand.

Pepper contains an alkaloid, a volatile oil and resin, amongst various other properties.

A few hundred years ago pepper was only known to grow in the East Indies, and the Dutch, who in the days of Queen Elizabeth had a monopoly of the East India trade, endeavoured to raze and burn all spice-trees not under their control. So successful were they for a time in thus "cornering" pepper that they were enabled to raise the price from 3s. to 6s. per lb. Few people could enjoy pepper with their meals in those days. But this monopoly so irritated London merchants that they formed the Society of Merchants and Adventurers trading to the East Indies, thus beginning our great Indian trade, which afterwards led to our Indian Empire.

For the last two hundred years pepper has been adulterated with rice and mustard husks, ground date and olive stones, and even bone dust and chalk. But even the best ground peppers of commerce are mixtures of different kinds: Malabar to give weight, Penang or Trang to give strength, and Sumatra to give colour.

The clove and the oil from it are familiar to all who love apple-pie or who have experienced toothache. But how many who have used this spice or oil know that it is derived from the dried, unopened flower bud of an evergreen growing in various parts of the tropics, especially in Zanzibar, Pemba, Penang, Amboyna, Madagascar, the Moluccas and the Seychelles? In

Zanzibar and the adjacent island Pemba the tree is said to grow in perfection. Introduced there about 1790, the clove-trees number about 5,500,000, covering some 60,000 acres, on the western sides of both islands, among the red and chocolate-coloured marls and sandy loams. At fifty years of age some of these trees are forty-five feet high, with a circumference of five feet.

The young trees are planted out in lines from twenty-one to twenty-five feet apart, and commence to bear about their sixth year, reaching their maximum yield at about fifteen years of age. Only one crop is produced each year, the trees commencing to bud about January or February, the harvest starting about July or August, and sometimes lasting four months, because the buds ripen unequally, and, therefore, the same tree may have to be picked two or three times. The clove must be harvested before maturity, otherwise it is useless for commercial purposes. The yield varies from four to ten pounds per tree. The best bearing trees are those lining the native footpaths and huts.

After picking, the cloves are dried in the sun for six or seven days, then packed in grass mats or gunny bags and sent to the Zanzibar Customs House for auction, the Government levying a 25 per cent. duty upon the produce. The bulk of the cloves are purchased by English and Indian firms, and are exported to London, New York and Bombay, where they are largely employed for the distillation of clove oil, used in drugs, perfumes and confectionery. The Pemba cloves are conveyed in dhows to Zanzibar, but owing to deterioration during this mode of transport they fetch a lower price. Before the Great European War of 1914 the Germans were the biggest buyers at Zanzibar of this commodity.

Ginger is another spice known in very early times

to the Indians and the Arabians, and from them exported to the Greeks and Romans. As an important item of commerce it appears in tariff lists at Acre, 1173, at Barcelona, 1221, Marseilles, 1228, and Paris, 1296. It is referred to in the Saxon leech-books of the eleventh century, and in the thirteenth century it is mentioned as costing 1s. 7d. per lb. Our chief sources of supply are Sierra Leone, the West and East Indies, and Egypt. The author has seen the plant growing upon the hillsides of Sierra Leone and seized the dry product in payment for rents overdue. He has also participated in exporting the commodity.

Two methods of cultivation can be adopted. That by which the best ginger is obtained consists in planting portions of selected rhizomes from the previous year's crop, care being taken that each portion of rhizomes planted contains an "eye" or embryo stem. These portions of rhizome can be placed a few inches below the surface of the prepared soil and about one foot apart, the process being much the same as planting potatoes. Thoroughly clear the land of weeds before planting the rhizomes, as the removal of weeds becomes difficult when the ginger plants have developed. Unless the rainfall is good, resort to irrigation, as the plants require a good supply of water. Ginger produced thus is "plant ginger." "Ratoon ginger" is obtained by leaving in the soil from year to year a portion of a rhizome containing an "eye." This "eye" develops in the normal way, giving rise to a supply of rhizomes in the succeeding season. "Ratoon ginger" is smaller and contains more fibre than "plant ginger," and the product obtained by this means deteriorates steadily from year to year.

The rhizomes are ready for digging when the stalks wither, this taking place shortly after the disappear-

ance of the flowers. The rhizomes are twisted out of the ground with a fork or a hoe. In performing this operation great care is necessary, as any injury inflicted on the rhizome depreciates its market value. Considerable experience is necessary in order to lift ginger rhizomes properly. The " hands " (complete rhizomes and adherent fibrous roots) are piled in heaps, the fibrous roots broken off, and the soil and dirt removed immediately, as otherwise it is difficult to get the finished ginger white. If the rhizomes lie long in heaps they are liable to ferment. As soon as the rootlets and excess of soil have been removed, throw the ginger into water to be ready for " peeling " or " scraping." In West Africa the washed and partially dried rhizomes are rubbed with sand, which removes the skin from the projecting pieces, but leaves the depressions untouched. Much of the sand adheres to the rhizome, considerably reducing its value, but the weight being thereby increased, the native prefers this method.

In peeling, the object is to remove the skin without destroying the cells immediately below it, as these cells contain much of the oil upon which the aroma of the best qualities of ginger depends. As the rhizomes are peeled they are thrown into water and washed; the more careful the washing the whiter will be the ginger.

Half-a-pint of lime juice to six or seven gallons of water produces a whiter root. After washing, the peeled rhizomes are placed on a " mat," consisting of sticks driven into the ground, across which are laid boards or palm or banana leaves, on which the ginger is exposed until dry. Uniform drying of the rhizomes is essential for the production of first-class ginger and to prevent mildew. Careful planters put their ginger out daily at sunrise and take it in each night

at sundown; in this way the operation of drying usually takes from six to eight days. The ginger, if not sufficiently white in appearance, has to be bleached by further washing, and, after being redried, is ready to be packed for export.

Unpeeled ginger is merely freed from its rootlets and excess of soil and then thoroughly washed in water or scalded in a boiler of hot water, and finally dried in the sun. The yield of ginger varies considerably with the climate, soil and methods of cultivation employed.

Among other important spices are the nutmeg and the cinnamon.

The nutmeg is the dried kernel of the seeds of a tree somewhat like an orange-tree, growing to about twenty-five feet high. The fruit, like a peach in size and shape, turns from green to yellow as it ripens. A tree is usually nine years old before it bears. The fruit is collected by hand and the outer coat thrown away. The inner coat or "mace" is flattened and sun-dried, losing its scarlet colour in the process, which often lasts for weeks. Then the shell is broken, and the nutmeg or kernel taken out, cleaned and packed for export. For a long time this trade was the monopoly of the Dutch Government, but a large trade is now done by Ceylon and the Straits Settlements, and the West Indies. The Calabash or Jamaica nutmeg, as well as the Californian and Brazilian varieties, are of little use as spices.

Cinnamon is a peculiar spice, because it comes from the bark, not the fruit, of an evergreen shrub which would become a tree if allowed to grow wild. The bark is only useful when it covers long willowy shoots, hence the plant is kept coppiced. The bark is cut longitudinally by a special knife and removed in strips, which are piled in heaps for a fermentation process,

after which the epidermis is removed by scraping with a curved knife.

The dried and contracted bark is then bound into "quills." When the Dutch held the monopoly of cinnamon in Ceylon the native who sold a stick was punished with death. In Ceylon the natives who perform these operations form a distinct caste; but cinnamon is now grown in, and exported from, many tropical countries.

CHAPTER VIII

RUBBER

OF all articles of commerce none perhaps is so surrounded by romance as rubber. A few years ago the motor car, motor cycle and motor bus were unknown, and even the pneumatic-tyred bicycle was uncommon. The popularity of the last-named vehicle first attracted the attention of manufacturers to the vast field possible for rubber—that peculiar, poisonous and elastic milky fluid, by secretion of which a few tropical plants protect their wood from burrowing beetles.

The discoveries of the possibilities of petrol quickened the activities of the rubber manufacturers. Motor cycles appeared, followed by motor cars and motor cabs. The solid-tyred bicycle and the horse bus are now things of the past.

The great demand for rubber had meanwhile induced many tea and coffee planters in the East to cultivate the rubber-tree, and ultimately led to the great boom of 1909-1910 which made rubber famous among financiers. This boom, like the South Sea Bubble, poured fortunes into the hands of a few and ruined many hundreds of others. While it lasted there sprang up in every tropical country innumerable plantations, or, more correctly, estates upon which were planted a few rubber-trees. The best of these estates were situated in Ceylon and the Malay States, where the shrewd tea planters, and others who had been anticipating this boom and foreseeing the possibilities of this

article of commerce, now reaped rich rewards for their silent and careful planting of rubber-trees for many years. Their estates were eagerly sought after, and bought at fabulous prices, while they themselves had directorships and other honours showered upon them.

Long, however, before a single rubber-tree was planted in Asia or the Far East the forests of Brazil and West and Central Africa supplied us with this useful commercial commodity. There, among damp, impenetrable labyrinths, in a temperature never below 75° in the shade, began the romance of rubber, or caout-chouc, as the American Indians of Mexico and Brazil called it.

As far back as the time when Columbus made his second voyage stories were told of how the natives played with great dexterity and nimbleness "with balls bouncing better than those of Castile"; how also they struck balls with any part of their bodies which were covered with the gum of a certain tree. Like many of the natives of the Congo and West Africa who to-day are tapping the wild rubber of their forests, those American Indians, who had no calabashes, smeared their bodies with the milky juice, allowing it to coagulate upon their warm bodies in lumps.

Torquemada at the beginning of the sixteenth century[1] describes the native methods of obtaining a "white, milky substance from the ulequahuitl, a shrub or small tree with round leaves of an ashy colour," from which also they extracted an oil to drink with cocoa to stop hæmorrhage.

Many writers have identified this with the Castilloa rubber-tree; but that species is a large tree growing wild in forests in its native country; its leaves also are oblong, measuring more than a foot in length, and of a green colour. Others have identified it with the

[1] *De la Monarquia Indiana.* T. II., c. xliii., p. 663. Madrid, 1615.

Guayule, which is certainly akin to the name mentioned by Torquemada, but can scarcely be called a tree, while the rubber has usually to be extracted from it by the use of solvents or mechanical methods.

The Castilloa, the earliest known species of rubber-tree, was first described by Cervantes at a meeting of the Royal Botanic Garden of Mexico in July, 1694. It grows wild in Mexico, Honduras, Nicaragua, Guatemala, Costa Rica, Bolivia and Peru, sometimes reaching a height of 150 feet. In the more southerly districts it abounds in dark, humid, almost swampy forests, and here it was that fearful atrocities, culminating with those at Putumayo, took place in connection with the collection of wild rubber. Aborigines were killed, tortured and mutilated.

Though the Spaniards were using caout-chouc to waterproof their cloaks at the time when Cervantes was describing the Castilloa tree, no attention was paid to the product by other European countries for many years afterwards. La Condamine, a French official visiting Quito in 1735, first called the attention of his Government to this commodity. In 1751 Fresnau, a Guiana engineer, wrote a treatise upon the subject which the French Academy published.

In England the first notice of rubber seems to have been that of Dr Priestley, who remarks that "india-rubber" will eliminate pencil marks, for which bread-crumbs had hitherto been used. At that time half-an-inch of "india-rubber" cost three shillings.

The expression "rubber" seems to have been derived from this simple use of the commodity. The prefix "india" originated either from the practice of applying that word to those parts of America which Columbus discovered, or because a similar milky, elastic substance had at this period been found to exist in

the *Ficus Elastica*, a tree almost like a vine, growing in Assam, Burma and other parts of India and Malaya.

The familiar rubber plant grown in our conservatories is a " Ficus," but in its wild state it throws from its branches slender roots which often grow larger than the original trunk.

From 1791, when the first patent for waterproofing was granted—the perfected " mackintosh " being introduced by the holder of that name in 1823—the uses of rubber, gutta-percha and vulcanite, which is manufactured from it, became largely extended. Yet it was not until the latter half of the nineteenth century that Europe was awakened to the industry of " black gold," as it was fantastically called, which had arisen in the wilds of the Amazon valley, and in the darker, lesser-known recesses of the Congo.

But in the meantime the Government of Brazil and the King of the Belgians had discovered the new Aladdin's lamp and the magic word and substance which opened up to their grasping avarice new, vast and undreamed-of sources of wealth.

In Brazil the new industry was taxed to the hilt, and the life of the collector became more and more unbearable as the tax rose. On the other hand, palatial buildings, mansions, palaces and every concomitant luxury appeared in the principal cities of Brazil as the wealth rolled in.

There are two methods of collecting the wild rubber in the Amazon valley.

On the islands of the delta it is largely collected by the residents or squatters on their own account, to enable them to purchase the necessaries of life.

On the various rivers, such as the Madeira, the Xingu, the Tapajos, the Purus and the Tocantins, where rubber

is the sole industry, the rubber is collected on a system of half-shares between the collector and the owner of the lands; but, as the landed proprietors discourage agriculture or other enterprise, the rubber collectors are forced to buy all their necessaries at the stores run by the proprietors. The stores are said to yield enormous profits. The earnings of the *seringueiros*, as the rubber collectors are called, vary from about 2·24 p. per day to about $600 per season.

From October or November, when the tapping season commences in this part of the world, and these rubber collectors enter the wild rubber country, they are isolated from the outside world for about seven months. Cruelties there may be, but they are not sufficiently appalling to attract the attention of those who investigate atrocities in Putumayo or Africa.

The story of the late King Leopold's enterprises in the Congo is another romance of rubber towards the end of the nineteenth century.

In 1884 King Leopold of Belgium formed an International African Association to extend commerce and freedom of trade and keep down slavery in Central Africa. With the co-operation of the explorer Stanley the new association, afterwards formed into a "Free State," received the sanction of the British Government. In 1891 the new state forbade the natives to sell rubber or ivory to European merchants, thus placing the people in the position of tenants, and appropriating the produce of the land. The local officials' salaries were made to depend upon the quantities of these commodities which they could extort, and every device, including maiming, and death itself, was introduced to achieve this end. In the earlier days the natives had tapped wildly and fought for the baskets to bring to the white man for generous pay-

ment. Now they were obliged to bring it in as a tax, and their reckless killing of the rubber vine made it necessary to penetrate deeper and deeper into the labyrinths of the forest to find the wherewithal.

And the forest of West and Central Africa is damper, drearier and more deadly than that of South America. There is nothing like it in all the world. Never can the author forget in such a forest the inky darkness which the sun could not penetrate, the solemn silence at noon disturbed only by the drip, drip, drip of the oppressive moisture from the leaves, and the wild terrors of the night in the howls or roars of animals and the incessant drone of multitudinous insects.

The wild rubber of Equatorial Africa is different also from that of South America, and chiefly consists of vines. The only wild rubber-tree of Africa is the *Funtumia elastica,* or silk rubber, to which reference is made later.

The Landolphia rubber vines are parasitic climbers, linking together forest trees by their dense, tangled masses of dark green, and bearing in profusion sweetly scented jasmine-like flowers turning to fruit which is sometimes edible.

They are found in every West African country, from Gambia to Angola, and also in the Congo, East Africa and Madagascar.

There are several kinds of Landolphia, of which the *owariensis* is the best. In the drier regions *L. owariensis* coagulates upon the wound almost immediately upon exposure to the air, whereas in moister places it runs from the cut in such a manner as to allow it to be collected in a vessel. The acid juices of the lime are added to hasten coagulation, when necessary; or the collector smears the fresh latex upon his naked body until enough has been coagulated to form a small ball,

which serves as a nucleus for winding on the strings of fresh latex as the new cuts are made.

The Funtumia rubber-tree is found wild in Sierra Leone, Liberia, Gold Coast, Southern Nigeria, the Cameroons, the Congo and Uganda. Its flowers are white or yellow, and each seed bears a silky plume about two inches long, which floats through the forest to propagate its kind. The author has seen natives felling this tree, as though it were a vine, in order to extract the rubber therefrom. This method of obtaining the wild rubber, common in Equatorial Africa, is more wasteful than the hacking of the tree by the *machadino*, or hatchet, in the Amazon forests.

As the Funtumia rubber does not coagulate so quickly as the Landolphia, the African natives cover the fallen tree with dry grass, which is set alight. Then the bark is bruised off with a stone and the debris washed, the smoked latex being separated from the bark.

The smoking of the wild rubber latex in the Amazon valley is performed more scientifically. The collector prepares a fire of palm nuts or resinous wood, into which he dips a ball or paddle covered with the milky fluid or latex. The smoke dries or coagulates the fluid, and other coverings of latex are then added, until a large mass of rubber has been dried either into balls or scraps. So much for the wild rubber.

The story of how the wild rubber plant became a plantation product is equally romantic.

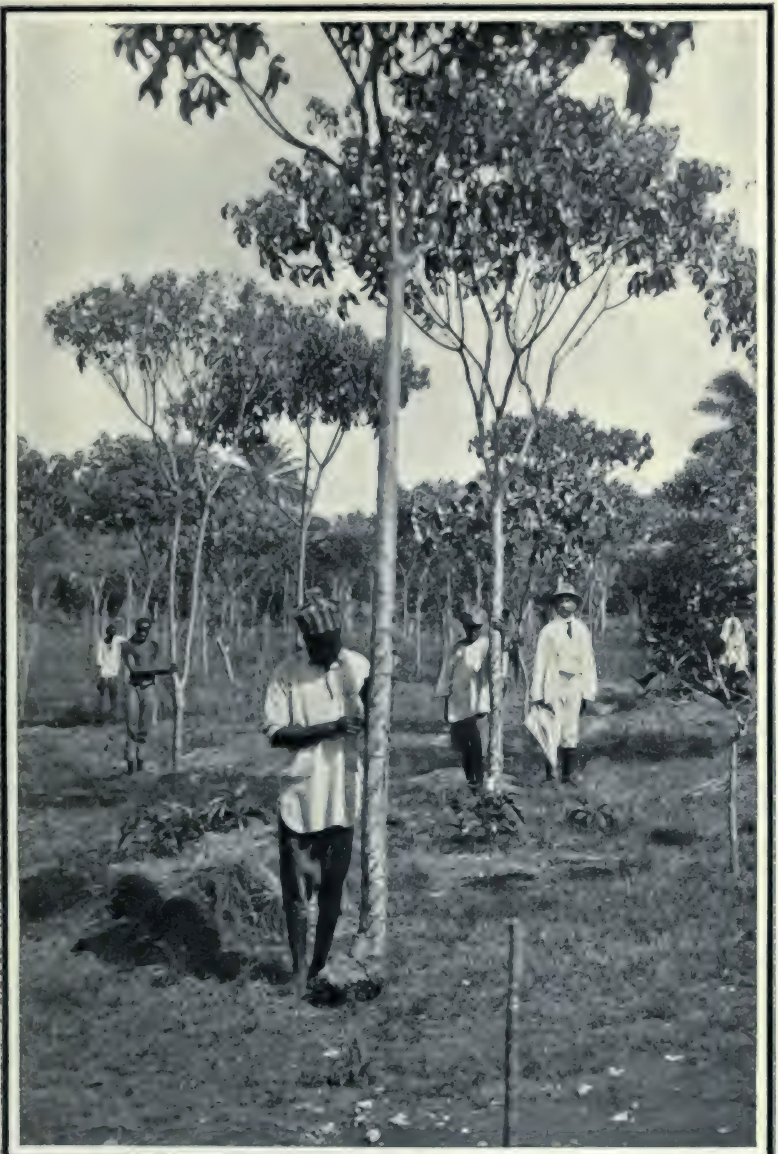
In 1876 about 70,000 seeds of the Hevea or Para tree were smuggled out of Brazil by Mr H. A. Wickham and forwarded to Kew Gardens, London. Of these only 2800 germinated. The same year the young seedlings were forwarded to the Perideniya Gardens at Heneratgoda, Ceylon, the cost being borne by the Indian Government. The plants were packed for

shipment in Wardian cases, portable glass-roofed boxes, each affording room for a supply of suitable soil and moisture.

By the use of these cases subsequent shipments of seeds have been enabled to germinate *en route*. A more common practice of transporting seeds at the present time is to pack them fresh and dry in tins filled with dry powdered charcoal, and coco-nut fibre dust or sawdust.

The following year some of the young plants were sent to the Straits Settlements, particularly Singapore and Perak, and a few to Madras and British Burma. Four years later, after the first flowering, and seeds had become available, another distribution was made, and Australia, Fiji, the Seychelles and West Indian Islands and West Africa were recipients of the new plantation rubber. As a result of several failures it was discovered that there was more than one kind of Hevea tree, and that *Hevea Braziliensis* was the only satisfactory variety.

In the meantime seeds of another kind of rubber-tree, the "Manihot," were collected in Brazil by Mr Cross and similarly treated. Experiments showed that the Manihot would grow in stony places and in comparatively poor soil, while Hevea required deeper, damper and better soil. It was also found to yield latex when two or three years old, whereas Hevea would not bear before four years of age. Investigation further revealed that there were several kinds of Manihot trees or plants, some yielding rubber and some not. The tapioca or cassava plant, for instance, is a species of Manihot. Of those yielding rubber, the *Manihot Glaziovii* or *Ceara* is generally considered the best. It was discovered by Dr Glaziov, a French botanist. *Manihot Dichotoma* or *Jequié* rubber,



From Photo lent by] [*British West Africa Association*

TAPPING YOUNG RUBBER TREES

The incisions are made with great care in order to avoid injury to the trees; in this case they are spiral. The gum is caught in small pans and coagulates on exposure to the air.

favoured by some experts, was discovered by Ule. Other varieties are the *Piauhyensis* and *Heptaphylla*.

The Castilloa tree has also become a plantation product in many parts of our Empire, through the instrumentality of Kew Gardens in distributing seedlings, while plantations of Funtumia have been opened in West Africa. Both varieties, however, take too long to yield, and the Castilloa, in addition, is uncertain and variable, although the author found it growing well and yielding on a plantation in West Africa which he visited a short time ago, taking part in the plantation work and personally tapping the Ceara, Funtumia and Castilloa growing there.

Never shall I forget my first night in Sierra Leone, when, arriving unexpectedly at the plantation through the miscarriage of a telegram, I groped my way up a hill to the European bungalow, accompanied only by two black boys, and the mysterious murmuring or buzzing of multitudinous but unseen insects. But the knowledge gained about African forests and plantations well repaid any misgivings one may first have experienced.

There are no horrors on a modern rubber plantation. There is no forced labour—that is, the labourers are free to leave at any month.

Life on a rubber plantation is never monotonous to the man who loves nature and his work. From six in the morning—when the roll-call of the labourers is taken—until six o'clock at night—when the planter records in the log-book the day's progress—there is always something to do and something new to think about. Even at the roll-call there will probably be a new arrival, or someone dead, ill or late. Accidents are frequent, not due to the work or climate, but to mischievousness or misadventure. One labourer will

be caught thieving. Another, fishing perhaps, out of bounds, will be seized by an alligator. A third will be incapacitated from a blow during a fight over women or a dispute in gambling the previous night. Sometimes there may be a boundary dispute, a forest fire, an attack by wild beasts; sometimes a strike for more pay, or against "clipping the copper," an expressive phrase used for "fining" the labourer for being late or other procrastination.

During the wet season, which lasts in West Africa from May to October, planting and weeding occupies most of the day, the dry days during the wet season being used for "tapping." During this period of the year every nerve has to be strained: first, to keep down the ever-growing grass and creepers; second, to plant up an adequate number of trees; third, to secure a good output from those bearing. In some countries the rubber can be tapped several times in the year and without encroaching upon the period for planting and weeding, but in West Africa the dry season is too prolonged and too hot for tapping to be done long after the rains have ceased without injury to the trees. The torrents of rain during the wet season wash out the latex if tapping be performed on the wet days.

During the dry season clearing and holing new ground and watering the young trees occupies the labourers. Watering is always done before nine in the morning and after four in the afternoon, when the power of the sun is lowest. Some plantations are irrigated by the Dutch system of trenching, but others, especially if situated on sloping or undulating ground, are watered by hand from irrigation pipes leading from an upper dam or river. One boy can water by hand about ninety plants.

Holing is the preparation of cleared ground for planting. Holes two feet deep and two feet square are made about three months before planting, the earth dug up being left exposed to sun and air. One man can dig sixty holes daily.

Not a little success in plantations depends upon wise holing, as an inch deeper in drier soil, or in areas exposed to a dry wind—like the Harmattan in West Africa—makes all the difference between success and failure.

Clearing the forest, preliminary to holing and planting, is effected by knife or fire. If firing be adopted the jungle is first cut down to about four feet from the ground, in the early dry season, and the burning carried out by a line of men walking with their backs to the wind and about fifteen feet apart. Every care is exercised lest a forest fire result. For this reason clearing by fire should not be resorted to when the uncleared portion is close to the planted area, or where there is superabundance of elephant grass and dry wood. On the other hand, the mere cutting of elephant grass, like lalang, is of little use, and fire or complete stumping is essential.

The clearing of a jungle or forest for the planting of rubber or other economical plants is interesting work. The virgin forest is difficult to clear; but in districts where the savannah or secondary jungle abounds the work is not so laborious. In either virgin or secondary forest, however, all the timber should be removed and burnt as well as felled. This is frequently forgotten. Upon this estate it had not been done previously when planting Manihot. The result was that white ants had bred industriously, and it was lucky indeed that no fungus had manifested itself.

Participating in the clearing for the third batch of

Hevea seedlings, the author arranged for the removal of the timber. All the old stumps left from previous clearings were screw-jacked and burnt, with good results.

Fungus and white ants are two serious pests which attack rubber-trees. Fungus lives on old tree roots and extends itself along rotten wood through the soil to the side root of the rubber plant, attacking the top root later. Only when the latter is affected does the tree display the disease. Then the leaves wither and the tree soon falls. Young rubber-trees are more exposed to this disease, because a newly planted area may have fungus present, while a plantation showing no trace after a few years is practically free.

White ants, or "termites," as they are more accurately called—for they are not white, and are really different from true ants—leave a kind of dull-looking earth or sand wherever they go. While among other social insects there is a great difference between males and females, and only the females are formed into "castes," the sexes are similar and both formed into "castes" among the termites. There was an idea prevalent that these insects did not touch green wood, but this is a fallacy. Termites often attack the shortened roots of rubber stumps, hence some prefer to plant out young seedlings in baskets when a few months old, to avoid shortening the roots.

Planting is usually performed, however, either with seeds at stake or stumps from nurseries.

Planting at stake means that the seed is planted straight into the place where the tree is intended to grow and bear.

In West Africa always, and in the Straits Settlements usually, stumps are preferred. Stumps are plants from nursery beds varying in age from nine months to two years. The tap-roots are shortened to about

two feet, the stem cut to a length of two or three feet and the side roots hacked back.

Hevea stumps are best planted 20 × 20, other rubber-trees 15 × 15. The collar of the plant must be above the soil or the plant will either die or bud beneath the surface.

Within about a month the stump sprouts afresh. Then begins a battle between the planter and the original jungle, the latter attempting to regain possession of the land, while a plethora of weeds spring up. Much discussion has taken place as to the advisability of clean weeding, some experts declaring this unnecessary and undesirable from a shade point of view. From practical experience the author unhesitatingly approves of clean weeding. Shading for the young rubber is secured by the planting of "catch crops," such as coffee or bananas. The catch crop is planted at least seven to eight feet on either side of the Hevea rows. There is then no danger of the Hevea suffering from the catch crop, or that the latter may be too much overshadowed by the Hevea.

The milky substance or latex in the Hevea or Para variety is in tubes which run practically parallel to each other. When tapping it, therefore, one is anxious to cut as large a number of these tubes as will be made to flow. With parallel horizontal cuts the greatest number of tubes can be opened; but the latex does not flow. The cut is therefore made obliquely. At one time the herring-bone system was the most popular method, but now the half herring-bone is adopted, and recent experiments tend to favour the left-hand cut only.

In the Ceara or Manihot variety the latex appears to be in cells rather than in tubes, and the bark is very rough and jagged. Hence it is not advisable to tap

it in the same way. For some time the practice was to strip the bark and use the herring-bone system, but now special tapping instruments are made to stab or prick the tree rather than to cut it in lines. Another reason for this is that while the latex from the Hevea runs down the cuts in a liquid state into cups placed at the bottom of the main cut, and is assisted to coagulate by acetic acid, that of the Ceara quickly coagulates on the tree directly it is exposed to the air, although acetic acid is frequently smeared upon the trunks previous to tapping.

Chloride of calcium is superseding carbolic or acetic acids as a coagulant, because it is cheaper, but if limes are grown upon the same estate as the rubber, the juice of that fruit is cheaper still, and just as useful.

The tapping surface of a tree is obtained by multiplying the height up to which the tapping is made (generally six feet only) by the girth of the tree. To obtain the total girth, multiply the average girth per tree by the number per acre.

Each tapper can make about a thousand cuts daily, so that one man is required for each hundred trees, or about one man per acre. If the trees be well cultivated, and planted not closer than 20×20, there is scarcely any limit to the yielding capacity of the Hevea after it is five years old; but the Ceara becomes increasingly difficult to tap as age advances because of its jagged bark. The author has known a twenty-seven-year-old Hevea tree planted in Penang to yield thirteen and a half pounds of rubber.

After the rubber has been coagulated, either by the acids or by the "smoking" previously described in this chapter, it is sometimes cleaned by two-roll machines similar to those used in the manufactories, but of lighter make and requiring less pressure. Only a few

plantations, however, keep these washing machines, the principal reason being that the manufacturer prefers to clean the rubber himself instead of having it washed at the source of supply and thus saving on the freight.

When there is at least 2 per cent. loss in weight on the fine plantation rubber, and considerably more in other classes of the commodity, one naturally asks why the manufacturer acts thus. The explanation is that when rubber is massed and its physical aspect changed it is so easy to amalgamate the inferior and superior qualities that most manufacturers prefer a dirtier rubber to the risk of being cheated.

When the latex is prepared for export in round receptacles it is called " biscuit," when in rectangular receptacles " sheet " rubber. If coagulated in bulk it is exported in " balls " and lumps, or cut into irregular pieces called " worm " rubber. If passed through a washing machine and cut in long thin bands perforated with small holes, it is " crêpe " rubber.

Crude rubber comes to the market in a great variety of forms—balls, strips, lumps and flakes mingled with bits of bark, leaves, sand and other foreign matter, which must be removed before it can be used for manufacturing purposes.

The gum is soaked in a pickling tank of warm water usually sunk to the level of the floor to facilitate the handling of the rubber. This removes waste surface matter and softens the rubber.

For some grades of Para rubber a power-driven circular knife is used for cutting the rubber into smaller pieces so that they may be more easily sheeted.

The rubber thus prepared is placed in a strong, heavy machine known as the " cracker." This machine tears or mangles the rubber, releasing the extraneous matter,

which is washed away by a stream of cold water playing on the rubber during the operation.

The torn rubber is next placed in the two-roll washer, which sheets it. Warm water is used first to produce stickiness, while the roller action forms it into sheets. Cold water is then turned on, and the sheets pass through the rolls repeatedly until completely cleaned. Then it is dried in a vacuum dryer or in drying chambers heated to 140° or 160° F.

To-day the rubber plantations of the Malay Peninsula cover about 700,000 acres; those of Ceylon, Sumatra and Java about 200,000 acres each; those of Southern India about 60,000 acres, and those of Burma about 30,000 acres. Most of this acreage is devoted to the Hevea variety, but many of the Southern India plantations are of Ceara. The Germans have planted rubber in nearly all of their tropical colonies, to the extent of over 100,000 acres, with about 40,000,000 trees. Most of these plantations are in East Africa and consist chiefly of the Manihot varieties.

These various plantations produce altogether over 60,000 tons of rubber annually, while the wild rubber from various sources brings the total of the world's supply to over 100,000 tons each year. During the "boom" the price of rubber per pound avoirdupois was as high as 12s. 6d.; now it is less than a quarter of that amount.

Yet the demand is rapidly increasing, and to meet it rubber is being found in and extracted from new kinds of trees and shrubs.

Among the best-known of these are the Guayule and the Balata.

The latter is a tree found most extensively in British Guiana, on the banks of the smaller rivers and creeks in the low-lying lands. In the county of Berlice,

where the Balata industry has been established for many years, nearly all the male population in the Canje district are now engaged in extracting rubber from this source. Owners of Balata grants have to take out licences, running for fifteen years. These do not include planting rights.

The tapping or bleeding of this tree is performed with a cutlass, the incisions being about one and a half inches wide and about ten inches apart, in a feather-stitch pattern, starting from the base of the tree to twelve and fifteen feet high. Each tree yields about a gallon of latex, or about five pounds of dry Balata. No tree is allowed to be bled until it is thirty-six inches in girth at a height of four feet. Only one half of the girth is bled at one time, and cuts take four to five years to heal, during which time the tree is not bled again.

The latex is collected in calabashes and poured into shallow trays or *dabrees* to congeal. From these it is removed in sheets and dried. The collecting is done by registered coloured labourers.

Bringing the Balata down the rivers for export has a romance all its own. The canoes, properly loaded, hold about five tons, and the crew of two natives or *djolkas* take great chances over the rapids. Down the centre of the river they come at racing speed to force their boat into the smoothest part of the rapid's current and shoot down the steep incline into the seething water below. Sometimes a wave washes over the canoe; sometimes they are unable to avoid some of the rocks or sunken timbers which abound in the dry season. Then there is usually a tragedy, and boat, Balata and crew are lost. The expense and risk of a cargo of Balata are therefore great.

The Guayule is a shrub or plant never reaching a

greater height than four feet, and growing principally on the bush prairies of Northern Mexico and the Southern United States. To extract the rubber from this plant, solvent and mechanical methods are necessary, the whole plant has to be cut down, and very careful washing is essential. There was a large factory at Torreon destroyed during the rebellion in 1914.

Among other plants producing rubber may be mentioned the Pingue, found in New Mexico and Colorado; the Tirucalli, found in Natal; the Venezuelan mistletoe, the Candellilia of Texas and North Mexico. Of these "Tirucalli" is being exploited by English syndicates with satisfactory results; and the "Candellilia" is being utilised by the Germans, though more for the wax it exudes than the rubber.

In the Pingue plant the most peculiar feature is that the root which furnishes the rubber will only flourish in dry, sandy soil or on mountain slopes. If grown on clay soil and along irrigating canals the roots become fibrous and rubberless.

The many possibilities of rubber have exercised the imagination of many clever men, each anxious to produce something new, useful or beneficial to mankind. Among such men was Charles Goodyear, who, distressed at the fearful and continuous loss of life at sea, applied himself day and night to devise the best sort of rubber life-preserver. He also invented the vulcanising process, which, by compounding with rubber a small amount of sulphur, renders it as hard as iron.

But rubber has recently been applied to a life-saving device which probably never occurred to Goodyear in the wildest flight of his imagination. The medical profession and the public having been greatly alarmed at the number of fatalities from taking accidentally tablets of bichloride of mercury, many people began

busying themselves in the attempt to discover a preventive. At last a Brooklyn doctor and a New York chemist together devised a rubber coating for the tablet thick enough to withstand the acids and digestive juices of the stomach. To prove the success of the experiment, the chemist swallowed a five-grain tablet prepared in this manner, and retained it without any injurious effects. Consequently, until a better preventive be discovered, bichloride of mercury tablets will have a rubber coating.

The underground room at Lloyds is now covered with a composition of rubber guaranteed to last twenty years; and the London Metal Exchange and one of the wards in Guy's Hospital is also covered with rubber flooring, that of the last-named having been given by the Rubber Exhibition Committee of the Rubber Growers' Association in London, which also loans rubber mats for placing outside the houses of invalids in noisy thoroughfares to deaden the sound of passing traffic.

There is a story told that Napoleon III., visiting the Paris Exhibition in 1854, saw some large rubber balls in one corner, and remarked that though he had often thought rubber might be used in warfare, it had never occurred to him that cannon-balls could be manufactured from it. Of course these rubber balls were only footballs. Yet to-day the British Government, if not ordering rubber cannon-balls, is testing a new kind of rubber plate for our men-of-war in place of, or in conjunction with, the present steel plates.

One word in conclusion about "synthetic" rubber. For many natural products an artificial substitute has been found, and the scientists were not likely to leave rubber unmolested. But there is a difference between "synthetic" and "artificial" rubbers. The latter consists of substances analogous to, but only

possessing certain characteristics in common with, india-rubber. The synthetic product must be identical with natural rubber, and instead of being a vegetable compound must be created from raw material and possess the same chemical composition. The most successful process has been that of polymerising isoprene or carburet of hydrogen; but this is expensive, and therefore the "synthetic" cannot compete with the raw article. Yet numerous chemists are attempting to reduce the cost of production and improve the quality and may at any moment be successful.

With the lowering of price and a plentiful supply we may possibly within a few years walk on streets paved with rubber and realise a noiseless London.

Just as this book is going to Press there is a public announcement that a portion of a well-known London thoroughfare is to be laid with rubber.

CHAPTER IX

TOBACCO

A STORY is told by a Frenchman of an imaginary conversation held about three and a half centuries ago, when Jean Nicot, French ambassador at the Court of Lisbon, first sent some tobacco to France as a present for Catherine de Medici.

A financier, seeing in the newly imported commodity a large source of revenue, hastened to the Cardinal de Lorraine and declared that he knew of a tax which would be cheerfully paid by the majority of people in the land. The Government, said he, must claim the exclusive right to sell a certain herb, which, reduced to a powder, can be sniffed up the nose as "snuff," or its leaf may be burned for the purpose of inhaling the smoke.

The Cardinal, anxious to hear of this plant, supposed that the aroma must be exceedingly pleasant and the powder possess some special healing power.

The financier, however, declared that its flavour is unpleasant, that snuffing weakens the memory and destroys the smell, while inhaling the smoke brings on nausea until you get thoroughly used to it.

The Cardinal, indignant, exclaimed: "And how many people do you imagine would be fools enough to punish themselves for tax-gathering purposes by smoking this plant or stuffing their nostrils with it?"

"More than 20,000,000 in France alone," replied the financier, as he left the presence of the Cardinal, who thought the man had become a lunatic.

History has proved that the financier was right. For while from the first kings and governments universally detested the use of tobacco, and the Kings of England and France, the Tsar of Russia, the Sultan of Turkey, the Shah of Persia, the Mogul Emperor and the Chinese Emperor prohibited its use in their dominions, the desire for it spread so rapidly that within a few years from its introduction to the Old World there was scarcely a people or a tribe which did not use it, and this despite the fact that it was, and still is, very heavily taxed in most countries.

Our poet Spenser spoke of it as "the Soveraine Weede, divine Tobacco," and the Chinese describe it as "the Queen Herb of the Rude Barbarian" and "that Herb of Amiability." Sir Walter Raleigh smoked a pipe of tobacco on his way to the scaffold, and the story is told that upon the first occasion that nobleman smoked a pipe his servant dashed a pail of water over him, thinking he was on fire.

Yet long before tobacco was discovered people had smoked. The peoples of the East from remote times allayed excitement and gave themselves comfort and pleasure by inhaling opium and similar fumes. Herodotus mentions the practice, and we are told also that the Gauls used hemp for smoking purposes.

The smoking of the tobacco leaf was first noticed by some sailors of Christopher Columbus' expedition to Cuba. The herb, they stated, was rolled in a maize leaf, lighted at one end, and held in the mouth by the other. A Franciscan monk who accompanied Columbus on a subsequent voyage noticed the snuff-taking of the Indians. The Spaniards also found that tobacco was both smoked and chewed by the natives of South America and that smoking was part of certain religious ceremonials. The priests of the god Kiwasa, in

particular, used to work themselves up to a frenzy by the vapour of tobacco leaves in ferment and combustion.

As early as 1518 the Spaniards opened up tobacco plantations in Cuba, and Portugal, almost immediately after, commenced planting the fragrant weed in Brazil. From Portugal the papal nuncio imported it into Italy. Pope Urban VIII. thundered against it and threatened excommunication against all who used it; but in spite of this the use of tobacco, especially in the form of snuff-taking, gradually conquered the Church, and Pope Benedict XIII. revoked all the papal Bulls against tobacco.

From Portugal also Jean Nicot sent it in the form of snuff to cure the headache of Catherine de Medici, but though the use of tobacco in this form became at once very popular in France, smoking did not become general there until the reign of Louis XIV., when a tax was levied upon imported tobacco. Even women had started the habit by that time, and Louis XIV. surprised his daughters in the act of trying the experiment. At Court, however, the practice was not prevalent and Louis XIV. did not like it. Neither did Napoleon. That famous man, although indulging freely in snuff, made a pretence of smoking simply out of compliment to the Egyptians and Persians, in the same way as he professed to lean to Mohammedanism. When the Persian ambassador gave him a handsome pipe, he simply opened and closed his lips without drawing, and when that would not act, tried merely to puff it. When, in private, he did at last manage to draw, the first whiff took the smoke down his throat and nose and blinded his eyes, and he exclaimed: "Take it away! It has turned my stomach. What pigs they must be!" When, however, he saw at a state ball a lady covered in precious gems, and on

inquiry found she was the wife of a tobacco manufacturer, he recognised the value of the commodity and promptly taxed it heavily.

No commodity of commerce has perhaps achieved so signal a triumph over obstacles, or turned the tables so completely upon its opponents, as tobacco. The Stuarts of England detested and forbade it; but when the unfortunate Charles I. sat in the guard-chamber as a prisoner Cromwell's soldiers blew tobacco smoke in his face; and when the Stuarts were finally ejected from the throne the costs of the revolution were defrayed by the revenue from tobacco.

In Russia, Tsar Alexis cut off the noses of snuff-takers and banished smokers to Siberia, then, finding that ineffective, inflicted the capital penalty of death. But tobacco found its saviour in Peter the Great, who, despite the prohibitions of the Church, encouraged it, with the result that to-day Russia is one of the chief tobacco-producing countries in the world.

In Turkey, where Amurath IV. condemned smokers to be beaten in a mortar, and in Persia, where the Shah condemned them to death, smoking has been for many years more prevalent than anywhere, except perhaps in Germany, which is the only country in Europe where the use of tobacco has always been popular at Court and not been persecuted. Frederick I. welcomed it, and Frederick II. fostered the cultivation of tobacco in his dominions.

The tobacco plant grows to four or six feet high, and has large, pointed oval leaves and pink or white flowers which are open and strongly scented at night. It will grow anywhere in a light, sandy loam, and was for some time cultivated in England, Scotland and Ireland. Oliver Cromwell's troopers were told off specially to ride down the growing crops, and Charles II. imposed

a penalty of £1600 per acre. In Roxburghshire, in the reign of William IV., a yield of 1000 lbs. of tobacco per acre was obtained, and the land was let at £5 or £6 per acre.

Only, however, in warm and moist climates can be obtained that full aromatic flavour in the leaf which marks its quality and value. There is little doubt that the most famous tobaccos, the Cuban, Turkish and Persian varieties, owe much to the climate.

The seed, which is very small—about 300,000 to the ounce—is mixed with sand or ashes, and sown in wet trenches, half in one direction and half in another, about one ounce to sixty square yards of ground. The seed is covered with a quarter of an inch of sand mixed with old manure. To protect the seed from insect pests the trenches are scorched to a depth of three inches; to protect them from frost and wind the beds are surrounded with planks and covered with muslin. After ten or fifteen days the seeds sprout. Then the beds are watered every day until a fortnight before planting out.

In Turkey when the plants are five inches high a plant is tested, after watering has ceased for a week, by twisting it round the finger. Should it not be brittle, it is transplanted to the permanent plantation, in which the rows are three feet apart and the plants eight or nine inches apart. When the plant begins to bloom the lower leaves turn yellow and should be picked and destroyed. The principal signs of ripening are limpness instead of crispiness in the leaf, and the change in colour from vivid green to a yellowish tinge on the lowest and oldest leaves, particularly at the tips.

To gather the leaves each plucker takes a single row of plants, with the thumb above and the two fingers beneath the leaf stalk.

The leaves are picked on a dry day, singly, in the early morning when they are poorest in starch, beginning with the bottom leaves, then the middle leaves, and finally the top leaves, the three kinds being kept separate. Any sucker leaves over six or seven inches in length are also taken. As a rule, about eight bottom, ten middle and six top leaves are obtained from each plant, and the yield is about 170,000 leaves per acre. The leaves after packing are taken straight to the drying-shed, generally built of teak and bamboo, with a roof thatched with sugar-cane leaves or "alang-alang." As the tobacco leaves are brought in from the fields they are brushed to remove sand and insects, and roughly sorted according to length, the top, middle and bottom leaves being still kept separate. At this stage great care is taken that the tobacco leaves are kept flat. Light is admitted as little as possible, as it is apt to spoil the colour of the finished leaves. The tobacco is considered dry enough when the midrib no longer obviously contains sap, though it is still flexible, and the leaves as a whole can still lose about one-fifth to one quarter of their weight of water for complete drying. The dry but still flexible leaves are next stripped from the rods and placed in large baskets for transport to fermenting-sheds. As each load of tobacco is brought into the fermenting-shed it is weighed and passed to labourers, who make it into bundles of fifty to fifty-five leaves, which are used to form the fermentation heaps, the three classes already referred to being still kept separate. The bundles are so packed on the outside of the heap that the lower ends (" butts ") of the leaves are all outside. The heap is built round a bamboo as a centre-piece, and this serves to hold a thermometer, which registers the temperature throughout the fermentation process.

The heap is then covered with a mat to which a slate or board is attached, and on which the temperature of the heap is recorded twice daily—at 6 A.M. and at 5 P.M. After about five days the temperature has risen to 60° C.

While the Turkish, the Latakia and various forms of American tobacco are obtained from the "tabacum" species of the Nicotiana plants, Hungarian tobacco and most of the East Indian or "green" tobaccos come from the leaf of the "rustica" species, which is a smaller, hardier and quicker-growing plant than the tabacum. The celebrated "Shiraz" or "Persian" tobacco comes from the "persica" species.

But while to the tobacco planter these various species and the conditions favourable for their growth are interesting, the tobacco manufacturer, who plays a great part in the commerce of tobacco, cares little for these distinctions. He knows that a particular variety grown upon the same plantation for two consecutive years may produce in the first year thin and dry leaves suitable only for cigarettes, while in the second season the leaf may be thick and therefore used for "plug" tobacco. The tobacco dealer consequently "classes" the leaf as "cigar," "pipe," "cigarette" and "chewing" tobacco. These are reclassified into "types," according to their flavour, strength or method of curing. Finally the "types" are "graded" according to aroma, size and texture.

To become expert in such classification requires a long experience, and the tobacco expert can accordingly command a large salary. Ill assortment of the leaf may ruin the farmer and enrich the dealer. A few leaves misplaced may destroy the value of the whole grade, and a shrewd dealer will then buy up the mistaken grading and regrade it.

Most of the leaf when reaching this country is "stripped" by taking off the stalk and midrib, but for the manufacture of "bird's-eye" tobacco the midrib of the leaf is retained, the "eyes" of the tobacco being merely thin slices of the stalk.

To make cigars, a core is formed of pieces of leaf placed longitudinally. These are called "fillers." A covering of perfect leaf is wrapped over it. This is called the "wrapper." Cigars are now made by machinery. So also are cigarettes, although to attract the purchaser some large tobacconists employ people to openly perform some of the process by hand. At one time the purchaser made his own cigarettes, and some people still prefer to do this.

Snuff is manufactured from the scraps and waste of the different mixtures, to which is added liquorice, beans, leaves and various perfumes. The mass is fermented, dried and ground to powder.

England imports annually from America alone an enormous amount of tobacco leaf, amounting to between 150,000,000 and 200,000,000 lbs. avoirdupois; and the price of the American leaf has been rising for many years.

The rise in price has been due to many causes. Firstly, there has been an increasing demand for the "weed," while the corresponding increase in production has been prevented partly by combination among tobacco planters to restrict planting and partly by the scarcity and dearness of labour. Secondly, there have been combinations of manufacturers to keep up prices. Thirdly, there have been wars.

War may affect the tobacco trade in two or three ways, but particularly in the increased freight rates and the possibility of the supply being cut off. If in addition to these tobacco as a luxury is made

a principal means of revenue for war taxation, the trade is also affected; but wise governments usually wait until a war is over before they tax tobacco, as tobacco is precious to the soldier in the trenches and to the tar at sea, and no commodity short of foodstuffs appears to be as much valued as a necessity in such conditions as "the fragrant weed."

CHAPTER X

COTTON

FEW commodities of commerce which are both useful and harmless can record a boycott against them by the British Government as late as the eighteenth century. Yet in 1700 the importation into Great Britain of cotton goods from India or elsewhere was strictly forbidden; and in 1721 Parliament imposed a fine of £5 upon everyone who wore cotton, and £20 upon everyone who sold it. The idea was to protect the woollen cloth and the Yorkshire sheep from which the wool came. So useless, however, are Acts of Parliament, when they attempt to frustrate or restrict natural and rational desires, or do not accord with the will of the people, that cotton continued to be worn and sold.

In 1727 the cotton industry had developed so much, particularly in Manchester, that Defoe wrote: "The grand manufacture which has so much raised this town is that of cotton in all its varieties." Fifty years afterwards more than 30,000 people were engaged in this industry in and about Manchester alone.

But the romance of cotton begins thousands of years before it became a common commodity in Britain. About five centuries before the Christian era Strabo told his countrymen of the cotton clothes worn by the ordinary natives of India, and of the flowery chintzes and vivid dyed cloths of those of superior rank, so that hand-spinning, weaving and dyeing were apparently established in India long before any other country had

adopted these arts. Our word "calico" is derived from the Indian port of Calicut, from whence the material came.

The Bible also records that "Joseph arrayed himself in fine linen," and that when the Tabernacle was put up in the wilderness "the women that were wise hearted did spin with their hands, and brought that which they had spun, both of blue, and of purple, and of scarlet, and of fine linen." Possibly, therefore, cotton may have been grown by the Egyptians earlier than by the natives of India. If so, it was only in small quantities and for home consumption. More probably, however, it was imported into Egypt from India. Certainly the first actual record of cotton being dealt in commercially is contained in *The Circumnavigation of the Erythræan Sea*, by Arrian, an Egyptian Greek, reference being made to Arab traders and their Indian cottons at the port of Aduli, on the Red Sea.

From India also it was imported into China. A thousand years before the Christian era the cotton plant is unmentioned in the accounts of the revenues and arts of China, but from about 200 B.C. until the sixth century A.D. cotton cloth is mentioned as a thing rare and precious, and was either bestowed as a present to emperors or paid in tribute. The Emperor Ou-ti, who ascended the throne in A.D 502, wore, we are told, "a robe of cotton." No person of distinction in Europe or Asia to-day would wear a material of mere cotton.

The cotton plant became generally cultivated in China in the eleventh century. In the twelfth century the cotton-tree was introduced into that country by the conquering Mongols. From that time it was extensively grown by the Chinese, but mostly for home consumption.

From the East the usefulness of the cotton plant spread to Greece, Spain and Southern Italy. Silk and linen clothing was manufactured in Spain during the tenth century and in Southern Italy during the twelfth century.

In Mexico and Peru the Spanish found cotton used for garments by the people of both countries in the sixteenth century. At the same time Venice and Milan were exporting every variety of article manufactured from cotton.

In England Hakluyt, the historian, records that Genoese ships brought cotton to Britain in the fifteenth century, while the Antwerpians shipped it to us from Lisbon and the Levant in the sixteenth century.

So successful in later days has been the commerce in cotton that it has encroached upon the use of wool and silk. Flannelette is entirely made of cotton, and cotton velveteen and sateen can be made so cheaply and extensively as to be used instead of real velvet and satin. "Mercerised" cotton resembles silk so much that it is often unscrupulously sold as such, while fabrics of mixed cotton and wool are far more in use than in the days of our forefathers. *The Times Annual Financial Review* of 1917 declares "it will most likely be used for the clothing of our soldiers and sailors to a much larger extent than hitherto."

Cotton comes from a most peculiar plant or tree. Nearchus, a Greek admiral, was amazed when he saw, in 327 B.C., trees "bearing bunches of wool." The cotton of modern commerce is gathered from shrubs, the cultivated plant of most cotton-producing countries being raised from seed every year to give better results, and, where there is any kind of winter, to prevent destruction. In Egypt the cotton plant is more of a tree, and in its native state is often a very large tree.

Ripe Cotton before First Picking

An experimental plot of the Khedivial Agricultural Society at Toukh.

The author has seen the wild tree growing in West Africa to the height of a hundred feet. In Sierra Leone, in which colony the natives call it "ungwe," there is a "cotton-tree station" on the narrow-gauge railway; and in the Sherbro country there is one famous old cotton-tree with huge roots, against which, if anyone stubs their toe, native superstition declares that he or she will certainly be afflicted with "elephantiasis," a fearful disease, marked by the swelling of human limbs to the size of those of the elephant.

In Nigeria also, the cotton-tree is credited with "magic." There is a story of it being struck, as Moses struck the rock, for water, while there is another legend that a cotton-tree dies when a famous chief dies.

Some kinds of cotton have brilliant green lint and green fuzz, the former fading to brown, then to cream-colour.

The cotton plant flowers about six months after planting, and the pods or bolls which form burst when ripe, displaying their white, cottony contents. Picking is done by hand. The crop gathered is "seed-cotton," consisting of the seeds, with the fibre or lint firmly attached. The lint is pulled off by hand or by a gin. One type of gin has rollers, between which the lint passes, whilst the seeds remain behind. There are also saw gins, in which the lint is pulled off the seeds by a rapidly rotating toothed disc or "saw." As the result of ginning, lint is separated from the seed. The latter is used on the estate, or crushed for its oil. The lint is made up into bales and compressed. It is then ready for shipment.

The grade and price of cotton are regulated by the following characteristics:—length of staple, fineness, strength, colour, cohesiveness, and regularity in all its

features, also by the amount of leaf, sand, seed, shell and immatured fibres contained in the sample.

Sea Island is the longest and finest cotton grown. It is light, lustrous and creamy, and is grown in the islands off the coasts of Georgia and Florida. It is used principally in making lace, gauze, imitation silk, etc.

White Egyptian is harsh, hard in staple, 80's to 90's, and is used principally for sewing thread, lace, muslins and doubled yarns.

Brown Egyptian or "Mako" cotton is soft, silky and brown, and is generally bleached for use as sewing threads and silk handkerchiefs.

Gallini or "Jumel" cotton is grown from Sea Island seed introduced into Egypt about 1830 by a Frenchman named Jumel, and is used for similar purposes as Brown Egyptian. M. Jumel in 1820 discovered cotton plants growing in the garden of the Governor of Dongola at Cairo. The Governor had brought the seed from Ethiopia. Mehemet Ali, then ruler of Egypt, was a very shrewd man, and he foresaw the probabilities of an industry based upon this product. He therefore encouraged M. Jumel to form gardens and plantations for growing this plant, and to procure the best seed available.

To-day about 2,000,000 acres in Egypt are devoted to growing the cotton plant, and another 1,500,000 acres were, in 1914, selected in the Sudan, in the Gezireh territory, lying between the Blue and the White Nile, below Khartoum, for the extension of this enterprise. Egypt, being practically a rainless country, is almost entirely dependent upon irrigation fed by the annual rise of the Nile. To obtain uniform supplies of water the Assouan dam was built. Two new dams below Khartoum, one over the Blue Nile and the other over the White Nile, have recently been erected.

Gallini cotton is not so much grown as formerly. The Mitafif product, which ripens earlier but is otherwise similar to Gallini, has largely taken its place. Great Britain takes about one half of the total Egyptian crop, which amounts to about 8,000,000 cantars each season.

Long-staple cotton is also grown in Peru, Brazil, Smyrna, the United States and Tahiti.

But the greater percentage of the cotton of commerce comes from the shorter staple variety, having a fibre up to about $1\frac{1}{16}$ inches. This is grown in the United States, India, Mexico, the East Indies, Persia, Africa and Australia, the United States producing about one half of the world's supply. Of the remaining countries perhaps the greatest advance in cotton production of recent years has been from Africa. West Africa now exports about 5,000,000 lbs., the East Africa Protectorate about 500,000 lbs., and Uganda 12,000,000 lbs. Nyassaland has also become a promising centre for cotton-growing.

In India cotton is picked all the year round, the harvest-time varying according to the district. In Pernambuco also cotton can be gathered all the year. In Brazil, however, it is usually restricted to the period between July and February. In the Southern States of America, and in Egypt, the land is usually prepared at the end of January and beginning of February, the seed sown in March and April and the cotton picked from September to December.

The fibre is tested by pulling the staple with the fingers. Some fibres have a breaking strain of forty-six grains, others of over two hundred grains. The longer and more regular the staples, and the finert he fibre, with a good colour and little dirt adhering, the higher is the price of the cotton.

Commerce in cotton is naturally affected much in

war-time, and large orders were given for the commodity during the Great European War of 1914-1918, by all the countries engaged, but more particularly the Governments of Great Britain, Russia and France. Cotton cords were found to be an excellent substitute for woollen cords in an emergency, and cotton velvets were in great demand owing to the scarcity of silk velvets. But cotton is also peculiarly affected adversely by war. The spinner or the manufacturer is not his own merchant. To quote Sir Charles Macara, the great cotton authority :

"The separation between the industrial and the commercial branches is all but complete. Nor does the subdivision end there. Spinning and weaving are, as a rule, separate businesses, and there is an endless further differentiation of work. Fine yarns are spun in the Bolton and Manchester districts, the coarser in Oldham, Ashton, Rochdale, etc. Some mills manufacture for the home, others for the foreign trade. The product of some mills is exceedingly bulky, of others it is so fine that, as the saying is, a week's work of a large mill can be taken off in a hand-cart. There is similar differentiation in the weaving districts. A mere novice in the trade could say at a glance whether a cloth had been made in Preston and Chorley, or in Blackburn and Darwen, or in Nelson and Colne, and an expert could probably tell you from examination of a cloth in which out of hundreds of mills it must have been manufactured. In addition, there are the separate processes of bleaching, dyeing, calico-printing and finishing, and the ready-made clothing industry. There is a similar differentiation on the commercial side of the trade. At each stage in the progress from the landing of the cotton to the final delivery to the home trade merchant

Photo by] [*Khedivial Agricultural Society*

TRANSPORT OF BALES OF GINNED COTTON ON THE NILE

and shipper, there is a fresh contract, expressed or implied, often loosely worded, sometimes with no condition as to time of delivery, at other times subject to the rule that non-delivery or non-acceptance at the time gives the other party the right to cancel."

Although Liverpool is the great market for cotton, much of the raw material comes direct to Manchester via the new Ship Canal, the cost of transit being much cheaper and the great central emporium for the sale of both yarn and cloth being the Manchester Exchange.

At the end of the eighteenth century the cotton master would attend the weekly market at Manchester and sell his pieces " in the grey " to the merchant, who afterwards dyed and finished them. At times goods were sold outright to the calico printers. Deliveries of prints would be made at the Manchester warehouse from the print works on Tuesdays, Thursdays and Saturdays in the busy season of spring and autumn, and the pieces would be sold to the drapers who flocked to the warehouses. Then the merchant or his representative would ride over the country showing their patterns to the mercers, and the cloths were afterwards forwarded on wagons by road. Three centuries ago the foreign trade was founded by British merchants or their agents who travelled, but it was not very long before the representatives or members of foreign firms came and settled themselves in Manchester, and from that time the latter have steadily increased in number.

To-day things have somewhat altered. Great commercial houses from almost all the world are still directly represented on the Manchester Exchange on market days, especially on Tuesdays and Fridays, when the floor is crowded with spinners, manufacturers, bleachers, dyers, printers and machine-makers. Yarn

and cloth agents are even more numerous. These find the customers for the spinners and receive substantial commissions. The Manchester warehouseman and shipper also take fewer risks, and stock less than they used to do.

The romance of cotton is not confined to its antiquity, or to the distribution of its seeds or plants or raw material to the various countries and workshops of the world. It has caused huge gambles and "corners" on the Exchanges; it has played a large part in the formation of influential trade unions and, correspondingly, federations of employers, and, in the crises of its commercial output, it has demonstrated that altruism is not dead among the people of England, even when it has to be exercised against their immediate economic needs in defence of principles and freedom.

In regard to the first, the loss sustained to the workers and employers through the gambling in cotton had, in 1904, reached such huge proportions—several millions, indeed—that Mr Balfour, then Prime Minister, received a deputation of masters and men; but, finding the Government helpless, the various associations of cotton spinners decided to hold each year henceforth an International Congress, which has done something to mitigate the evil.

In regard to trade unions, the workers engaged in the cotton industries were among the first to form such associations, and their leaders have often assisted the employers in advancing the interests of the industry and combating shipping rings, while the associations have contributed, with the employers' federations, towards relief of famine-stricken natives of India, minimising cotton crises, and advancing the interests of the British Cotton Growing Association.

But perhaps the most human incident in the romance

of cotton, which serves as a fitting conclusion to this chapter, is found in the attitude of the Lancashire cotton workers at the time of the great Civil War in the United States. That war between North and South stopped the supply of the raw material, upon which a great part of the population of Lancashire depended for their bread. The South was blockaded by the North, and, at the most intense period of distress and starvation, a meeting was called in Rochdale by a Liverpool association of Southern sympathisers, formed to promote the breaking of the blockade. After the address the people passed a resolution censuring the lecturer for endeavouring to mislead them. Workless, cold and hungry, they felt that the cause of the North in America was for Freedom and Right. Somehow they felt it to be their cause. And so no organised cry went up from the suffering populace to break the blockade which, while it attempted to strangle slavery, also shut out cotton.

CHAPTER XI

SILK

TO be arrayed in silk has always been a mark of distinction and an object of ambition. In antiquity the secret of rearing the silk-worm and preparing silk was for centuries known only to the Chinese, for although the Persians and Babylonians appear to have known and used this commodity, it seems to have been procured by them from India, that country depending in turn upon China for its supplies.

Aristotle was the first Greek writer to mention silk and its source; and it is alluded to by Ezekiel (chap. xvi. 13) as a clothing of the greatest luxury. Silk does not appear to have been known to the Romans before the time of Augustus; and for many years afterwards it was only in use by a select few. The Emperor Tiberius, indeed, forbade any man to wear this costly fabric. The Emperor Aurelian refused the request of his wife to procure for her a robe of pure silk because of its expense, "it being worth its weight in gold." Heliogabalus is said to have been the first Roman to wear silk entirely; and from the period of his reign the use of the article became more general. About this time also it began to leak out that silk came from an insect specially reared.

The story of how the secret sources of silk were gradually revealed, or rather betrayed, to the Western world is essentially romantic. A famous Chinese Empress, Se-ling-she, wife of the Emperor Hwang-te,

who lived about 2640 B.C., and is credited with the invention of the loom, was known to pay personal attention to the rearing of the mulberry-tree, and of the silkworm. Not till about 300 B.C., however, was the connection with silk discovered by outsiders, and then only by the Japanese through Korea, some people of the latter country presenting Japan with four Chinese girls who had been initiated.

According to Indian tradition, the secret was revealed to them—at a slightly later date—by a Chinese princess carrying into India some eggs of the insect, and some seeds of the mulberry-tree concealed in the lining of her head-dress.

From India it spread to Persia and the Central Asian states. Greece, Rome and Byzantium were supplied through the Persian trade route, and Justinian endeavoured through the Prince of Abyssinia to divert the commerce of this valuable article from the Persian route. His attempt failed, but in A.D. 551 two Persian monks who had, while studying in China, learned the secret successfully, carried off some eggs of the Chinese moth to Constantinople by concealing them in a hollow cane. From here were produced all the varieties of silkworm which are known to the Western world. Under the Byzantine Empire the preparation of silk was extensively developed. It was introduced into Sicily in 1146 by Roger II., who set up a silk factory at Palermo; from thence it passed to Italy and Spain in the thirteenth century, and to France and the Netherlands in 1521. In 1564 a working gardener of Nîmes formed the first nursery of white mulberry-trees.

Refugees from Antwerp to England in 1585, during the persecutions of the Protestants by the Roman Catholic Church, introduced the industry into England. Only during recent years has the necessity for seeking

silkworm eggs from the East again arisen; but the cultivation of the silkworm in England has been a failure. The most notable attempts were those of James I., and of the British, Irish and Colonial Silk Company in 1828.

The eggs of the Chinese moth are hatched by artificial heat. They are very small, one hundred weighing about a grain. Over the hatching-trays are placed punctured pieces of paper. The worms when they break their shells creep through these holes to the light, thereby also scraping off any pieces of shell which if adhering would kill them by constriction of the skin. The temperature for rearing them is from 62° to 75° F. The lower the temperature the slower their growth, but the bigger the cocoon when they spin.

The insects are fed upon mulberry leaves, but they will also eat lettuce leaves. The cocoons are boiled in an alkaline solution to which glycerine is frequently added. Then they are placed in a basin in which is a semi-rotating brush to remove the outer waste shell and to pick out the continuous threads.

Next the cocoons are placed in a hot-water basin of a reeling machine, where they are perfectly cleansed, while a fixed number of threads are wound into a single thread of uniform thickness. Two or more singles are next spun or twisted into a yarn; two or more threads twisted together thus being called a "tram."

Silk used in this state is called the "weft" or "shoot." "Thrown" silk is formed of two, three or more singles twisted together in a contrary direction to that in which the singles of which it is composed are twisted. This process is called "organising" and the product "organzine."

Some cocoons are preserved for rearing purposes. These are collected, freed from the floss and placed in

a temperature of from 66° to 72° F. About twelve days after, the moths emerge from the cocoon, and coupling at once takes place. The males are then thrown away and the females placed in the dark until they lay their eggs.

Although the rearing of the silkworm has not been so successful in more northern countries, it thrives well in many sub-tropical climes, and it is quite possible that at one time the moth was not peculiar to China, but the Chinese were the only people sufficiently advanced and enterprising to use and develop it. In Madagascar, for example, where the mulberry-tree grows well, there are two species of silkworm, one indigenous and the other introduced from China, which yield very resistant silk. Unfortunately, owing to ignorance and neglect on the part of the natives, the silkworms have degenerated, and this is reflected in the yield and quality of the cocoons. The silk, being reeled by primitive methods, is only suitable for the manufacture of coarse materials for local use. But the Government is improving the methods of cultivating the mulberry-tree, of rearing the worms and of reeling the silk. Large quantities of mulberry plants and silkworm eggs have been distributed gratuitously. Apparatus for stifling and drying the cocoons has been purchased by the colony and is placed freely at the disposal of the rearers. Experts are sent on tour through the villages to give instructions in the care of the worms and on treatment and prevention of disease. As a result the industry has developed in the upland regions. The cocoons which the natives bring to the markets are now of good appearance, firm to the touch and resembling those produced in France. Samples of the silk have been tested at Lyons and have given satisfactory results.

A special form of silk is spun in India and manufactured in India and Europe called "tusser" silk.

The tusser silkworm is found wild throughout the low hills of the central tableland of India, being absent from the Himalaya mountains and from the alluvial plains. The worm feeds on many shrubs and trees and is collected in large numbers from the jungle, the cocoons being resold during the months of May and June to the rearers of the insect for commercial purposes. The female cocoons are larger than those of the male. There are usually two crops in the year. Almost smooth, of a grey colour, with darker veins across the outer surface, the largest are, when mature, about two inches long by one and a quarter broad. The inner layer of the fibre is loose, forming a soft cushion for the insect inside. The silk obtained has a glossy but coarse-looking appearance, but is very durable, and no kind of silk so closely resembles sealskin. Carpets and the particular velvet known as Utrecht velvet are made from it, also cloaks and mantles for winter wear.

The centres of the traffic in this silk are in Bengal, Berar, the Nizam's country and the Central Provinces.

The silk reaches the spinner twisted into the form of knots and in batches called "books" or "hard yarn." It is said that one thread of silk will support a weight equivalent to that borne by a flax thread in the ratio of 136 to 47, and to a hemp thread in the ratio of 102 to 49.

The industry of silk manufacture, with its various processes and by-products, employs many thousands of people all over the world; but this belongs to the romance of manufactures rather than that of the raw material.

The story of commerce in silk would not be complete, however, without a few words about the

"Yorkshire Silk King," as the late Lord Masham was popularly called. Elsewhere, in the chapter upon "Wool," it has been narrated how this eminent pioneer in commerce improved and extended the woollen industry in England. After achieving notable success in that sphere of commerce he turned his attention to silk.

Noticing in a London warehouse one day a pile of "chassum" or waste silk from the pierced cocoons of silkworms, he asked what was done with it; and upon being told that it was sold as rubbish he promptly bought the lot at one halfpenny per pound. Taking this material to Manningham, where he had a factory, he quietly made experiments with it, aided by a Spanish inventor and workmen whom he specially selected and who were skilled in various processes of silk manufacture and machine construction. The result was that, in 1865, after the expenditure of ten years of labour and nearly half-a-million in money, he succeeded in making velvet and plush from this waste material. To-day many thousands are engaged in the Manningham factory turning waste silk into imitation sealskins, velvet, carpets, poplins, plush ribbons and similar articles of use and luxury.

CHAPTER XII

WOOL

BIDEFORD'S proudest possession is the Long Bridge, a noble structure 677 feet in length, which was built in the fourteenth century. The story is told of how Sir Richard Gurney received divine instructions through a dream to begin the work of construction where he should find a stone firmly fixed in the ground, but when building operations were commenced—for which pious work Peter Quivil, Lord Bishop of the Diocese, granted indulgences—no solid foundation could be found. The inhabitants, therefore, threw in bales of wool—there was formerly an important wool industry in the town—and upon these bales the bridge is supposed to stand!

When it is remembered that for many years wool was the principal industry in many parts of England, it is not surprising that the commodity should figure largely in the history and the folklore of the nation.

But the story of wool goes further back than the history of one nation, as far indeed as the domestication of animals by primitive man.

In all probability people used the skins of wool-producing animals as wearing apparel as soon as they satisfied themselves that a covering for the body was desirable or expedient, and subsequently because of the ease with which it can be made into thread and the comfort of its texture.

We possess some very early records of the uses to which wool has been put. The earliest wars mentioned

in the Bible appear to have been over the possession of pasture-land for flocks and herds. Sheep and lambs were used before money for purposes of exchange; and we read that one hundred *kesitas*, or lambs, was paid by Joseph for a field in Shalem. But while the patriarchs and other nomads kept sheep, the Egyptians abhorred the practice. In England the sheep was a domestic animal long before the Roman occupation.

During the first century the Romans established a woollen industry at Winchester, and the product was "spun so fine that it was in a manner comparable to the spider's thread."

The only rival to English wool for many years was that of Spain. Columella, a famous Latin writer, made frequent references to the superior fleece of the sheep of Spain. In the eighth century the Saracens conquered Spain, and, among other civilising influences, developed the woollen industry there, and it is on record that in the thirteenth century, in Seville alone, no less than 16,000 looms existed. The Spanish cloths were pleasing and costly, but after the Moors had been driven from the country the industry fell into decay. Subsequent efforts to revive it met with little success. Meanwhile in England wool-farming had become an important occupation, competing strongly with agriculture. Flemish weavers settled in England as early as the reign of William the Conqueror; Henry II. instituted the woollen cloth fair in the churchyard of St Bartholomew, and Edward I. passed the first Act prohibiting the exportation of wool.

After the Black Death sheep-farming became a menace rather than an impetus to national prosperity, and manorial estates underwent a remarkable change in many parts of the country—notably in Suffolk, Essex, Hertford, Kent, Worcester, Shropshire, Northants,

Leicester and Norfolk. Sheep-farming became the order of the day, because of the prices commanded by the fleece. Waste lands were enclosed, "Stock-and-Land" leases were withheld, and the tenant farmer gradually disappeared. Landowners found that sheep-farming was more profitable than wheat-raising, that it was no longer necessary to live on their estates, and that the old-fashioned tenantry was a hindrance and an unnecessary expense. Consequently depopulation of the rural districts proceeded apace. The Government was then forced to intervene and to change its front; and it decreed that no flock should consist of more than 2000 sheep, and that the holding of more than one farm was illegal. Unfortunately these measures did not have the desired effect, because the Justices of the Peace were themselves interested in sheep-farming, and did not enforce them actively.

Probably, the most remunerative mercantile wool-producing breed of sheep is the Merino. Authorities disagree as to whether it was a native of Spain, or introduced from another part; but there is a volume of evidence in partial support of the theory that the breed was introduced by the Phœnicians, who with the Carthaginians monopolised the trade for centuries. Nevertheless Spain can be regarded as the home of the Merino, and until about four centuries ago she alone had specimens of it.

Attempts to introduce these fine-woolled sheep into England were made from time to time, and in the reign of Edward V. 3000 specimens were imported from Spain. Queen Mary, wife of Philip II. of Spain, brought over another consignment.

During the reign of Elizabeth every effort seems to have been made to encourage the rearing of sheep and the allied industries whose raw material was the wool,

A Merino Ram

Showing length of Staple and great density of clean bright Wool.

and the free exportation of wool was permitted. It was during this reign that the Woolsack was placed in the House of Lords to remind the Lord Chancellor—so it was said—that the source of national prosperity was the ban that had been placed upon the exportation of wool.

But from 1660 onwards the export was again stopped, and Parliament passed stringent but ineffective and narrowly conceived measures to protect this industry from foreign competition. It became a crime to export wool or to wear clothes of any other material, while another Act of Parliament prohibited the exportation of sheep, under pain of "branding on the forehead, and the loss of the right hand." Not until 1825 was this prohibitive legislation altogether repealed.

Even, however, while legislation was restricting the wool trade, enlightened individuals at Rome and in the colonies were adding fresh chapters to the romance of wool.

In the eighteenth century there lived Sir John Sinclair, the first president of the Board of Agriculture, a man of indefatigable energy. Among the many achievements of a life well spent were the making of roads, the building of bridges, the construction of harbour works and the erection of mills. By his personal labours the British Wool Society was established. This society had for its object the stemming of the serious deterioration in the quality of British wool—then the principal commodity of the country. He himself led the way to practical improvement by importing 800 sheep from all countries at his own expense, and in the result Scotland and the border country became famous for the famous Cheviot breed.

The story of the sheep and wool industry of Australia

from its small beginnings to the gigantic position it holds to-day, with the ups and downs, successes and failures, of the intervening years, reads like a romance.

The names of M'Arthur, Marsden, Riley and others, who, in good report and evil report, amid many discouragements and disappointments, persisted in their opinion that Australia could maintain a large population of valuable sheep, deserve to be held in everlasting remembrance. One of the earliest official notes that exists, is in a despatch dated 25th September 1788, by Governor Philip: "One sheep only remains of upwards of seventy which I purchased at the Cape of Good Hope, on my own and the Government's account. It is the rank grass under the trees that has destroyed them: for those who have only one or two sheep, which have fed about their tents, have preserved them."

John M'Arthur first set foot on the island continent in 1790. Three years later he had a few sheep which had been sent from India and from Ireland. About this time King George III. put up for auction his flock of pure-bred Merinos, whose home for many years had been at Kew. M'Arthur, who was in England at the time of the sale, secured several representatives to add to his stock in Australia. In connection with this purchase, it is interesting to note that Sir Joseph Bankes, who was not only representing the King at the sale, but was also a keen buyer, reminded Sir John that the Act of Parliament prohibiting the exportation of sheep, under pain of "branding on the forehead, and the loss of the right hand," had never been repealed. Not to be denied, M'Arthur continued bidding, and in spite of the antagonism of the governors of the day he laid the foundation of the great sheep industry which has been the main factor in Australia's great and

wonderful development. In 1788 only twenty-nine sheep were known to be on the continent. A hundred years later there were 97,983,960.

In the early days sheep-farming in Australia was confined to New South Wales, but in 1826 a few Cotswold sheep were imported into Tasmania. Later Merinos from Saxony arrived in considerable numbers, and to-day the island contains about as many sheep as it can conveniently hold.

Early in the history of sheep-breeding in the island continent the paramount question was whether sheep should be bred for their fleece, or for mutton, or for both. Experienced authorities and breeders had their own views of the matter, but, in these days of freezing appliances, the whole aspect of the sheep industry has changed, and to-day wherever it is possible to keep the heavier and maturing varieties of sheep in addition to the pure Merino, such sheep are to be found.

Almost all the English breeds of sheep, as sires of lambs suitable for breeding, have their supporters among Australia's sheep-farmers. The Lincoln, the Leicester and the Shropshire seem to be most generally in use, but there are many who favour the Border Leicester, the South Down, the Oxford, the Cotswold or the Dorset Horn, and in damp, marshy districts the Romney Marsh undoubtedly holds a place of its own. Yet it is the Merino that has made Australia famous as a wool-producing country.

Some years ago rams of the Vermont strain were imported from the United States to increase the weight of the fleece, but the results were unsatisfactory.

At this stage it may be interesting to include a paragraph on the composition and description of wool. Animal wool, which nature has created to cover an

animal body, is a fibrous growth, and differs from hair inasmuch as it is more elastic, and the scales that clothe the core of the fibres project further and are more pointed. Thus the fibres are capable of being spun into thread. The specific gravity of wool is 1·3 and it is very similar in composition to horn. In its natural state it is charged with about 40 per cent. of a grease called yolk or "suint." Wool is sold either as it is shorn from the sheep, called "in the grease," or after it has been scoured. When it is stated that most clips lose in weight 45 per cent. to 50 per cent. on being scoured, it is easily realised that a considerable saving is effected in haulage, railway, steamer and other charges where tonnage enters into the calculations. The bulk of the wool of commerce comes into the market in the form of fleece-wool, the product of a single year's growth cut from the body of the living animal, the finest being lamb's wool, taken from the young sheep when only eight months old.

The principal countries from which wool is exported for textile purposes are: Australia, New Zealand, South Africa, South America and India. A negligible quantity is now produced in Great Britain and on the Continent, if we omit the products of certain localities which have special applications—*e.g.* Cheviot, Silesian, and Southdown wools.

The home of the Cheviot is in the border country between England and Scotland, but like most other breeds its origin is obscure. The fleece is of the middle-wool combing class, is neither fine nor coarse of staple, and averages about four inches long.

The first attempt to establish the German or Silesian Merino family was in 1768, by Mr Von Vinke, who introduced some Saxon Merinos. Ten years later he crossed them with pure Spanish Merinos, and in 1776 his

stock was increased by 300 Merinos from Spain, which were secured through the interest of Frederick the Great.

The wool of the Merino families represents the first grade, and varies in diameter and length according to the breed or breeding.

The Southdown breed has its home on the Sussex Downs, and the original stock was somewhat small, with dark face and legs, and occasionally short horns. The wool was formerly short and the fleece thin, but both have been considerably improved.

The sheep, of course, is not the only animal from which wool is obtained. The camel yields a very short wool, while the "alpaca" and the "llama," animals of South America, give us the wool called by their respective names. From the goats of Angora come the mohair, and the most costly wool in the world is yielded by the Cashmere goat of the Himalaya Mountains.

The raw material of these various kinds of wool is imported into Britain in large quantities for the large factories and industries connected with the woollen, yarn and dyeing trades, which are dependent upon external sources for about five-sixths of their raw supplies. These woollen industries are, therefore, particularly susceptible to fluctuations of price, and there is considerable gambling in this, as in many other commodities, in the special exchanges, the Wool Exchanges, at which the raw material changes hands. They are also very vulnerable to war dangers, and when it is remembered that before the Great World War Germany consumed one quarter of the total English production of worsted and mohair yarn, it will at once be seen that there was considerable justification for the restriction of the export of raw wool from this country. Whatever loss was felt for the

moment, at the loss of her German customer, was more than compensated by the large demand for woollen manufactures, not only on the part of the British Government itself, but for other troops of the Allied forces, which sent to English manufacturers for equipment in clothes and arms. To quote *The Times*:

"Night work and even Sunday work have been common in the districts making heavy woollen cloth, blankets and flannels for the Allied troops. Fabulous weights of yarn have been spun also for hosiery, and the employment of almost every knitting machine of suitable gauge in the out-turn of garments for the forces has largely swelled the demand for crossbred wool. The unofficial orders for the home knitting of comforts have given the spinners of fingering-wool the busiest months in their history. Stocks of any woollen articles of approved military pattern were bought up at once and a sweep was eventually made of everything that could be reasonably substituted for the regulation articles. Everything warmth-giving and unobtrusive in colour, including goods of obsolete fashion, were convertible into gold, and although the transactions were of limited magnitude, they may be called the most remunerative of their size. Odd and inconvenient lots of raw material were likewise brought from a discount to a premium and the clearing of these gave a double satisfaction."

One of the most interesting romances in connection with commerce in wool is that of Sir Titus Salt, Bart., the founder of the great wool factories, six stories high, and covering an area of twelve acres, at Saltaire. To him we owe the introduction of the mohair wool into England, and the use and development of the alpaca wool. Seeing one day in 1836, in a Liverpool ware-

house, a pile of dirty-looking woollen bales which no one would buy, he took some samples to his home at Bradford. Scouring, combing and inspecting these critically, he found therein a long, glossy wool which he believed could readily be adapted to the manufacture of light, fancy fabrics, for which there was then a great demand. His friends and relatives laughed at him, and would have nothing to do with his proposals to start a new industry; but he exclaimed: "I am going into this alpaca affair right and left, and I'll either make myself a man or a mouse."

Returning to Liverpool he bought the whole lot of three hundred bales at the price of 8d. per lb., and set to work. First, he tried to weave alpaca with woollen and worsted warps, but his results were not successful, and to make a fabric from alpaca alone was too costly and impracticable, because the product would be too heavy. So he wove it with a cotton warp, and produced the new fabric known to us.

With the glossiness of silk without its expensiveness, light, elegant, suitable for summer wear and more durable than any other similar article, it captured the popular fancy at once. Other manufacturers quickly followed his example, and in a few years the imports of alpaca amounted to over 2,000,000 lbs.

Another romance of the wool industry is attached to the names of Mr Samuel Lister, afterwards Lord Masham, and a Mr Donisthorpe.

The wool-combing machine invented by Cartwright in 1792, and subsequent improved machines on the same model were only suitable for "combing" certain classes of wool, and when Mr Lister began business in 1838, wool of the fine, long-stapled kind was combed by hand. Donisthorpe devised a new machine, in which Mr Lister saw possibilities of further develop-

ments. The latter, therefore, bought the former's patent rights for £12,000, and taking the inventor into his confidence the two set to work together, and succeeded in turning out a machine capable of combing the finest wool. For every machine sold—and they were in great demand—Mr Lister received a royalty of £1000. Later, he bought up all the rights of two Continental inventors, and at one time owned five combing mills in England, three in France and one in Germany. Still later he turned his attention to the utilisation of silk waste; but that story is told in another chapter.

CHAPTER XIII

TIMBER

THE fascination of the forest is fearful. Men have indulged in many forms of commerce and industry, but few have been so fascinated by their work as those who have explored and felled the forest. Whether among the cold, dark fir forests of northern climes, or the close, damp forests of the tropics, where creepers intertwine the trees, and creeping things innumerable, but often unseen, add a fearfulness all their own, the call of the bush never fails to gain a response.

Never can the author forget, nor can he adequately describe, the feelings which thrilled him as he hewed his way through the evergreen forest on a West African hill. Equally romantic, though perhaps less exciting, were his sensations in witnessing the floating of the beautiful mahogany logs down the river and the surreptitious stopping of many such logs by crafty natives waiting in the creeks to substitute smaller and inferior logs wherever possible without detection. Not a few timber exploitation companies have been ruined by these means, for the mahogany usually frequents the depth of the forest, many miles from the shore, and the various governments of West African colonies prohibit the export of the logs below a certain size. For the real mahogany of West Africa, from Gambia to the Cameroons, is of great size, while the wood is most beautifully figured, and fetches a high price; hence the desire to keep up the standard.

On the western side of the Gold Coast and Ashanti the mahogany forests have been well exploited, the Pra and Ankobra rivers affording special facilities for floating the logs to the coast. There are yet huge virgin forests in Liberia and the Ivory Coast, especially near the Cavalla river, which deserve the attention of the capitalist.

In Honduras, from which some of the best mahogany used to be procured, and in the neighbouring states of Mexico and Central America, the difficulty of securing the logs is yet greater. There, it is true, a contractor may only give a few dollars for a single tree, but there are few water-courses at hand upon which the logs can be floated to the port, and the mahogany hunter has to "blaze" a way to the scattered mahogany-trees in the jungle, so that they may be found again when required. When the logs have been cut they have to be hauled and rolled to the nearest creek, which may be many miles away, and the labour thus involved is rather costly. No wonder that monster logs secured under such conditions have fetched enormous prices over here. One such log from Honduras, measuring twenty feet long, five feet three and three-quarter inches deep, and containing between four and five thousand cubic feet, was sold at 1s. 10½d. per cubic foot. Messrs Broadwood, the pianoforte makers, are known to have given as much as £3000 for three logs of mahogany cut from a single tree and measuring fifteen feet long and thirty-eight inches square. So beautiful, it is said, was this wood that when highly polished "it reflected the light in a most varied manner, like the surface of a crystal."

In strange contrast to the value which Europeans place upon mahogany is the estimation in which it is held in some of its native lands. In the state of

Chiapas, in Mexico, for example, is a bridge spanning the Rio Michol one hundred and fifty feet long and fifteen feet wide, built entirely of mahogany. Not one of the massive timbers were sawn, for there was no sawmill near, so they were all hewn out with the axe. The bridge is used for foot and team traffic.

Remarkable also in connection with the present value of mahogany in commerce is the record of the purposes for which it was first used in England. A brother of Dr Gibbons, a well-known surgeon living in the latter part of the seventeenth century, brought over from Central America some planks of this wood as ballast in his ship. As the doctor was then having a house built for himself in King Street, Covent Garden, his brother sent him these planks, hoping they might prove of service. The carpenters, however, found the wood too hard and laid it aside. Mrs Gibbons, wanting a candle-box, insisted upon a carpenter named Wollaston getting stronger tools and making this required article from the discarded wood. When it was completed the doctor decided to have a bureau made from the remainder. The fine colour and polish of this article so pleased the Duchess of Buckingham upon a visit to the doctor, that she wanted a similar bureau ; consequently mahogany and Wollaston the carpenter thenceforth became much in demand.

An inferior, softer and lighter-coloured mahogany grows on the damp lands around the Bay of Honduras, but this is more properly known as bay wood. The choice Spanish mahogany from Cuba, once so popular, is seldom used now except as a veneer.

Mahogany, however, is comparatively a modern timber in commercial use. Centuries before Christ other woods of the forest were in demand, and played a great part in the romance of commerce.

The cedar of Lebanon was renowned in antiquity. Assyrian kings transported huge beams of it to Nineveh for the erection of royal palaces. Solomon is said to have employed 80,000 hewers to bring the cedar of Lebanon to Jerusalem for the First Temple and his palace, 10,000 being sent at a time to prepare the timber and boards. Sesostris, the Egyptian conqueror, built his fleet of the same wood. For the roofing of the Second Temple of the Jews and for the celebrated carving of the gigantic statue of Diana at Ephesus the cedar of Lebanon was also requisitioned.

The huge demand for this renowned cedar, and the havoc caused thereby in the forest, caused the Roman Emperor Hadrian to forbid any further cutting of the trees. After his death, however, depredations went on as before, until, at the end of the nineteenth century, only four hundred trees remained. Then a special ordinance was issued by Rustem Pasha, Governor-General of Lebanon, forbidding even a bough to be broken. No fire might be lighted in the vicinity, no tent or other shelter be erected, no beast of burden brought near. Oxen, sheep, goats or other pasturage cattle found within the proscribed limits were promptly confiscated.

Some of the cedars which remain are still of the finest type, the trunks measuring forty feet or more in circumference and the wide-spreading limbs covering a circle of two to three hundred feet. When the traveller gazes upon them he is reminded of the words of Ezekiel, who, in likening the Assyrian monarch to the cedar, says: "Behold, the Assyrian was a cedar in Lebanon with fair branches, and of high stature, and his top was among the thick boughs. . . . His boughs were multiplied, and his branches became long. . . . The fir trees were not like his boughs, and the chestnut trees were not like

his branches; nor any tree in the garden of God was like unto him in his beauty."

The vitality of the cedar is wonderful, and is said to be due to its slow growth. A cedar fifteen or twenty years old is very small, sometimes little more than waist-high. The white cedar, or cypress, and the red cedar, or juniper, do not belong to the same family, but the red cedar shares some of the Lebanon's characteristics, and resists the ravages of time.

The cedar of Lebanon was introduced into England in the seventeenth century, and several may be seen in Kew Gardens. The wood has a sweet odour.

Almost as ancient in renown, and far better known and used in Europe, is the oak, the monarch of European forests. Virgil describes the oak as

> "Jove's own tree
> Which holds the world in awful sovereignty."

Many ancient people believed that a deity dwelt among oaks. The Greek oracle of Dodona stood in an oak grove. The Druids of Gaul and Britain celebrated their mystic rites among the oaks and under the mistletoe which hung from their boughs. For centuries later, "oaks" formed the "boundaries" at which periodically the Gospel was read, and boys were beaten to remind them of the parish which was their home, beyond the bounds of which they might not go without special permission. Gospel Oak derives its name from one such tree which remained standing in more modern times. The English Parliament of 1290 is said to have been held by Edward I. under the Parliament Oak in Clipstone Park. This oak was a large tree even at that time, and is believed to be the oldest in England. The only other oaks which compete for this claim are the King's Oak in Windsor Forest—which is quite hollow and

accommodates ten people for luncheon inside—and the white oak of Brighton, nearly twenty-six feet in circumference, which is said to have been at least a century old before the first Anglo-Saxon came to Britain.

There are two varieties of oak, one with sissile, the other with pedunculated leaves, the latter being the more common. The timber of the one is reddish, that of the other white and hard. The bark is used for tanning and as a coarse kind of febrifuge; the decaying leaves for producing heat by fermentation; the sawdust for dyeing in drab, brown or fustian, and the acorns for feeding swine. Its timber was once used for England's Navy, and our sailors are still called "Hearts of Oak."

One of the greatest of English admirals in the eighteenth century occupied his old age in wandering about the country with a pocket full of acorns, which he would plant, so that in the centuries to come England should have plenty of sound oak beams to build her men-of-war.

That was in the day when our ships as well as our men were "hearts of oak." The Super-Dreadnoughts of to-day are not built of oak; but in spite of that the admiral's idea was good. For, although the thought of commercial profit probably never entered his head, there are few more valuable properties to-day than plantations of soundly grown oak.

In most of Britain's luxurious and stately homes oak is found in the panelling or the flooring, and while the popularity of other woods ebbs and flows, oak seems ever to be in demand.

A peculiar property of oak is that when submerged in sand or water it will last for centuries unimpaired. Piles from old Roman bridges constructed of oak have been tested and found to be as perfect as they must have

been when driven into place nearly two thousand years ago. A hundred pounds sterling has been paid for a single oak-tree raised from the bed of a river in which it had lain for many years; and not so very long ago a great find was made of an entire oak forest submerged in a Russian river, the Moksha, which had apparently, centuries before, by some volcanic disturbance, been altered in its course, and undermined the forest.

Many other timbers are sometimes termed "oak"—the Indian "teak," for example, and the Australian Casuarina tree.

The African oak is a very useful, hard timber found in tropical Africa, and often takes the place of British or American oak.

Among other popular British timbers are those of the beech, the elm, the birch.

The first is reddish-white, heavy, moderately hard and very fine and close-grained, and is used for mills, butchers' blocks and the wooden shoes or *sabots* so customary on the Continent.

The second is coarse-grained, very strong and very durable under water, hence it is used for keels and piles. The piles of old London Bridge were made of elm, and lasted six hundred years.

The birch, a close-grained wood of various shades from white to yellow, or even red, is used for ladders and cheap chairs.

But perhaps the greatest timbers of commerce for everyday purposes come from the north of Europe, the United States and the Far West of Canada, which are really the great centres of the lumber trade.

Most of the timber used for building ordinary houses, for floors, beams, rafters and roofs, comes from the fir or pine. In any timber yard you may see long, thick beams, sometimes called "balks," sometimes "hand-

masts." These are whole trees stripped of their bark and squared. But beside these lie piles of boards of various length and thickness. These are called "deal," and are brought ready sawn from the countries where the fir grows in greatest profusion—Canada, Norway, Sweden, Finland, Russia. The white boards are chiefly from the spruce fir, the yellow and red from the pine. Yellow deal, one of the most important timbers of Europe, comes from the Scotch fir or pine, which is found all over Europe.

Milton compares the spear of Satan to a lofty pine:

> "His spear—to equal which the tallest pine
> Hewn on Norwegian hills, to be the mast
> Of some great ammiral, were but a wand . . ."

Virgil and Ovid relate that the walking staff of the giant Polypheme was a pine.

This wood also is said to have been used with cedar in the building of Solomon's Temple.

The valuable resins of pitch and tar are exuded from the fir and pine.

The pitch pine from the United States is heavier and stronger than any other pine, and is in great demand for bridges, railroad cars and railway sleepers.

Weather plays a great part in deciding the value of timber. For example, few people would imagine that absence of snow would double the price of timber, yet this is so.

For nearly five months of the year the surface of these lumber countries is buried deep under the snow, and the thermometer in the heart of the pine forests sometimes falls to 30° below zero, or 62° of frost. Now, while a full-grown pine can stand almost any degree of cold, the young tree cannot. But snow is one of the best non-conductors of heat or cold, and if there be a fall of snow a foot deep a thermometer

showing 60° on its surface will, if buried beneath the snow, rise about 30°. Snow, therefore, is an excellent blanket protecting the roots from intense cold and covering the natural warmth of the soil. A snowless winter kills the young trees, and if snow ceased our timber supplies from Northern Europe, Asia and America would cease also.

The demand for timber was never so great as to-day, and 85 per cent. of that demand is for pine. The result is that many countries, particularly some of our Australian colonies, have for many years planted pines. Previously South Australia had alone annually imported it to the amount of about £200,000 sterling. Now her imports in this wood are slightly declining as her pine forests mature, but only a few species of pine will grow in Australian climatic conditions. The statesmen of Australia have other reasons, however, for encouraging forestry. They say it will rear strong men amid healthy conditions and prevent the congestion in the cities.

Curiously enough, while Australia is importing pine it has been exporting to us, sawn up in small blocks, a timber known as Jarrah—a kind of eucalyptus, the trees of which cover about 14,000 square miles of Australia—to form the wood pavements for London and other cities.

The forests of Western Canada are now the great centre of the lumber trade in pine, fir and similar wood, and some large companies have leased as much as 596 square miles of forest-land in British Columbia and in neighbouring territory, and erected the most modern sawmills for exploiting this sort of timber. Much of it is used to-day for making paper pulp, but of this use of timber more will be found in the chapter on paper.

The quality of timber varies a good deal with the age of the tree, the time of felling, the condition of seasoning and the part of the tree from which the logs are cut. On the whole, the crushing resistance is the best general index of the strength of timber. Oak has a strength of about 4½ tons per square inch. Red pine has a crushing strength of about 2½ tons per square inch. The density is obtained by preparing prisms about $4'' \times 4'' \times 6\frac{1}{2}''$. These are carefully measured and weighed, and the heaviness computed. The transverse strength is determined on bars about $4'' \times 4'' \times 36''$ span, which are loaded at the centre. The coefficient of transverse strength is the value of f in the equation $f=\frac{n}{l}=\frac{3}{2}=\frac{w}{bd^2}$, where w is the breaking load, l the span, b the width and d the depth of the bar.

Perhaps the best illustration of the transport of this kind of wood is to be found in the picturesque old white Norwegian or Swedish sailing barque or brigantine which may be seen discharging her cargo of deal plank through the clumsy square holes in her stern, in ports all over the world. The vessels always appear battered, storm-beaten and of ancient date, and the skipper seems to carry his whole family, besides numerous animals, upon whatever voyage he embarks.

The annual timber exports of Sweden alone amount to over 200,000,000 kronors (or about £12,000,000), about one-fourth of the total value of Swedish exports. Of this amount about one quarter is sold to England and about one-ninth to France.

Timber coming to the Port of London is unloaded by a number of contractors employed by the Port of London Authority, which discourages casual labour. These find gangers who contract to pile away the timber at a schedule of prices per standard. The

gangers pay their mates and themselves certain rates per hour and share out any profit left after paying these wages. They commence at 8 A.M., and finish about four o'clock in the afternoon.

Of the fortunes made in timber in the northern parts of the United States quite a volume could be written. Here is one episode. The story is told that Mr Weyerhauser, the late Lumber King of America, at twenty years of age started as a workman at a sawmill in Illinois. Six months afterwards he was managing the mill. A few years later he entered into partnership with a Mr Denckmann and bought the mill. Visiting the Wisconsin forests, he foresaw that in spite of their vastness they were not inexhaustible, and that within a few years the demand would equal the supply. He bought up some timber-land, and for twenty-five years continued quietly to buy, until he had secured 50,000 square miles. He died worth about £100,000,000 sterling.

Others have made fortunes, not in the timber itself, but in the bark stripped from it, for dyeing purposes.

Oak bark is collected from felled trees and sold either in pieces about a yard long ("long rind bark") or chopped into small pieces ("hatched bark"). English oak bark contains from 12 to 15 per cent. of tannin, and is richest when collected from trees from thirteen to twenty-five years old. Oak bark is also obtained from Belgium, Holland, France and Sweden, the Belgian being considered the best. A number of coniferous trees yield barks suitable for use in tanning. In Scotland that of the larch is employed; in Austria that of the Norwegian spruce.

"Hemlock bark" is obtained from the "hemlock" fir, a tree widely distributed in Canada and throughout the northern part of the United States, in which

countries it forms the staple tanning material. The bark contains from 7 to 10 per cent. of tannin, and yields a plump, rather reddish leather.

The bark of the common chestnut contains practically as much tannin as oak bark, but is rarely used for tanning purposes. It is employed as a source of extract in France, Italy and Austro-Hungary, where it is available in large quantities. "Chestnut extract" contains from 30 to 40 per cent. of tannin, and furnishes a firm, tolerably heavy, but rather greyish leather, which darkens somewhat when kept. It is imported principally from Italy and Austro-Hungary, and largely used in the United Kingdom as one of the ingredients of a mixture employed in tanning sole leather.

Willow barks are employed, especially in Denmark, Belgium, Holland and France, for tanning leather intended for the manufacture of gloves and similar articles, and yield a peculiarly soft, pliable, light-coloured leather. Wattle barks, also known as mimosa barks, are obtained from a series of acacias indigenous to the southern parts of Australia, and now largely cultivated in Natal. The best Australian species are the "broad-leaved" or "golden" wattle of South Australia, the bark of which may contain as much as 40 to 50 per cent. of tannin, and the "golden" wattle of New South Wales, yielding bark containing 20 to 25 per cent. of tannin. After stripping, it is merely dried in the sun, and either cut into small pieces or ground to a powder. Wattle bark is used in the United Kingdom for tanning sole leather. It yields a solid leather with a faint pink tint.

In primitive times the forest was at once man's shelter and his source of food supply. The fruits, berries and roots on which he lived grew there.

Many of the animals that he sought for food or the

skins to clothe himself were forest-dwellers like himself, and in tropical regions the leaves and bark of certain trees have always been used for clothing.

Men cut down forests, then, for two reasons: firstly, to clear the ground for agriculture—the forest region affording a rich soil for growing crops; and secondly, to use the wood of the forest trees for building and for various other purposes. In modern civilised life the products of the forest, both tropical and temperate, still contribute an enormous share to man's welfare and progress; but the forest is hewn for its lumber and its bark rather than to clear the land for agriculture, for with the increase of civilisation the demand and the use for timber correspondingly increases, and commerce in this commodity is continually expanding.

The outbreak of the Great World War in 1914 caused the British Board of Agriculture to make a special inquiry into the supplies of pitwood for British collieries. It was ascertained that 7,900,000 tons of pitwood existed in England and Wales, and 3,800,000 could be made available by extraordinary fellings. The latter quantity would meet the requirements for one year, while the total existing quantity would be used up in the course of two years, in both cases exclusive of stocks and future imports.

Sir W. Schlech, then Professor of Forestry at Oxford, pointed out that "had woods been planted in Great Britain and Ireland thirty years ago our position would have been quite different now that unexpectedly this war has placed us in a very serious position as regards pitwood, not to speak of telegraph poles, building timber and even firewood. As regards the latter, we have to send 1000 tons of firewood every month and 100 tons of charcoal every week for our troops in France and Belgium. Steps have been taken

by various Governments since 1885 in the right direction, but very little has as yet been done to increase the area under forest. The financial aspect of afforestation has been placed too much into the foreground and it has been forgotten that there may be other considerations of great importance for the welfare of the people and the State as a whole.

"It is the bounden duty of the Government of this country to take early steps to increase the area of the forests in these islands. There is plenty of surplus land available now yielding a revenue of perhaps a shilling an acre all round, if so much. There are large stretches of land unfit for cultivation and yet quite fit to produce forest crops. As long as the area is sufficiently large to justify placing a woodman in charge and also sufficient to be placed under systematic management, say a minimum of 500 acres, we shall have all that is required."

CHAPTER XIV

FRUIT AND WINE

FROM the very earliest times the various fruits of the earth have been sought for and exchanged by man. History is silent as to those who first discovered that certain fruits were refreshing, while others were poisonous, and history is silent also as to who discovered that the juice of certain fruits gave an intoxicating sensation and made men feel specially exhilarated for the time being. Certain it is, however, that far back in primitive times man found many fruits from which he might distil an intoxicant, and others which gave refreshment without intoxication. Of the former in particular the grape was an early favourite, and Noah, we are told, "planted a vineyard and drank of the wine thereof," not wisely but too well. The seeds of the grape have been discovered in the Neolithic lake dwellings, and we read of its cultivation six thousand years ago in ancient Egypt.

The finest vineyards of modern times are undoubtedly to be found in France, Italy, Spain and Portugal. Florida, Virginia and California in the New World, and South Australia, Victoria, New South Wales and South Africa in the antipodes, are also great cultivators of the vine. Australia in particular is threatening seriously to rival France with its "Burgundy," which is becoming more and more appreciated. In the beginning of the nineteenth century Cape Colony was a more prolific producer than now, and Great Britain imported more wine from South Africa than France.

Turkey, Rumania, Switzerland, Algeria and Tunis also cultivate the vine and express its juice, but in smaller quantities, and more for home consumption. In Greece certain vines are extensively grown, but not so much for the expression of the juice as for the drying of the fruit, for which there is a great demand, all over the world, in the form of raisins and currants. Raisins are the dried fruits of one variety of vine cultivated in Asia Minor, Greece, Persia, California, South Africa and at Valencia in Spain; sultanas are similar dried fruits from a seedless variety of the same species; while currants are the dried fruit of the Black Corinth or Zante grape. To turn the grapes to raisins, the ripe bunches are generally cut from the vine and placed in the sun on sloping floors until the fruit is sufficiently cured. In some parts the drying of the grape is retarded by sprinkling the bunches with oil. This reduces evaporation and preserves the fruit during transport.

The muscatel raisin is packed in fancy boxes, the ordinary raisin shipped in bulk. The best of both kinds come to the London market.

In France a special kind of wine is made from these dried grapes, specially imported for the purpose from Greece to the extent of 100,000,000 kilograms annually.

The special centres of the "currant" industry are at Patras and the Isle of Tante.

Although different kinds of wine are made from the dried grape, and are considered by many people very delicious, they are not considered so invigorating or nutritious as those of the fresh grape, and one of the greatest commercial uses of this fruit has been in the demand for the commodity for making wine.

Modern wine is made by allowing the juice of the grapes to ferment after passing them between horizontal

Stereo Copyright, Underwood & U.] [*London and New York*

VINEYARDS COVERING THE SUNNY FIELDS AT AY, NEAR ÉPERNAY, IN THE CHAMPAGNE DISTRICT, FRANCE

Almost every acre of land is subjected to the most intensive culture.

cylinders, which press out the juice without crushing the stones. The expressed juice is called "must."

During the fermentation of red wine the whole mass rises to the surface; if the stalks have been left in the fermenting bowls, towards the end they sink, the liquor becomes coloured and acquires an alcoholic flavour. The colour and flavour depend chiefly upon the length of time the "must" remains in the bowls, and for light, red wines the sediment must not be left in the "must" longer than forty-eight hours; but different districts and countries are celebrated for their particular wines. Thus France is specially noted for its red Burgundy—dating back to A.D. 1110, when the monks of Cipeaux received vineyards from Hugues de Blanc, Lord of Vergy—and its red claret from Bordeaux, first made fashionable by the Marshal de Richelieu.

White wines are prepared in quite a different manner, and are not made solely from white grapes. The juice when pressed out is either drawn off and placed in casks to ferment, the sediment being extracted as soon as possible, or the grapes are taken direct to the press and care exercised to avoid too great pressure to prevent the "must" becoming coloured by the expressed juice of the stalks. In either case the lees are placed on hurdles and the wine dripping from them is added to that first drawn, whereas in preparing red wine the juice subsequently obtained from the lees by represssures forms an inferior quality wine. Sometimes also it is necessary to add sulphuric acid or charcoal in preparing white wine to eliminate discolouring.

To make the "sweet" white wines it is necessary to repeatedly collect the "scum" which accumulates at the surface of the various vessels in which the white wine is fermenting. This causes the fermentation to

be incomplete, the fermentation being generally stopped by fumes of burning sulphur. For "dry" wines the scum is allowed to remain and the fermentation becomes complete, the sugar being converted into alcohol and carbon dioxide.

"Pale" wines are procured by further pressing the sediment.

Special wines, such as Asti, Muscat and Champagne, are prepared by special methods.

Champagne, for example, which owes its origin to Dom Pérignon, Governor of the Abbey of Hautevillers, employs many thousands of specially skilled operators in the beautiful district in North France so cruelly ravaged by the Germans in 1914-1918.

The grapes are carefully selected from the best vines and the vintage taken at once to the press, while the juice from the first pressure is reserved for the preparation of the best wine. The fermentation is carried out in large vessels, each containing 200 litres of clarified "must." The fermented contents are collected in barrels and transferred to a huge cask, in which it is mechanically mixed, and, if found deficient in alcohol, pure spirit is added. After being clarified in fresh casks, and sugar added according to the kind of wine required, the contents are bottled, corked and wired, the bottles being stocked for three or four years, when they are placed on slanting racks with the necks pointing downwards. Sediment thus collects in the bottom, and when the corks are allowed to fly off the force of the gas generated expels the impurities. At this stage a syrup of sugar steeped in old wine is added, the bottles hermetically sealed, wired and tinfoiled. Then they are recellared to acquire the effervescing qualities through accumulation of carbon dioxide.

The story of Dom Pérignon's introduction of cham-

pagne is interesting. Fond of experiments, he noticed that the blackest grapes produced a white wine, which kept good, instead of turning yellow like the white wine made from white grapes. He also discovered that a cork was a superior stopper. Before his time flax dipped in oil was used to seal the bottle. After several experiments with the grapes of his district he made champagne, and it was introduced by the Marquis de Sillery to the Court, a dozen damsels dressed as bacchanals carrying the bottles wreathed in flowers. When the corks popped and the liquor fizzed in the new glasses specially made for this wine, "great exultation prevailed."

. . . .

The apple is perhaps the most common of all fruits and at the same time one of the most helpful and refreshing to man. Certainly it is one of the first fruits of human culture, and legends of all climes and countries appear to proclaim it of more ancient origin than any other. Poets and painters have pictured it as the fruit on the Tree of the Knowledge of Good and Evil, which tempted Adam and Eve in the Garden of Eden. Aphrodite's apple of discord, the sacred apple of the Hesperides, the golden apples of the Norse sagas, the "healing" apple of the Arabs—all speak of its antiquity and importance, and not without reason.

The acids of apples neutralise the excess of chalky matter caused by the consumption of much meat, they clear the complexion and diminish acidity in the stomach; while the phosphorus—of which apples contain a larger percentage than any other fruit or vegetable—renews the brain and nervous system.

There is an old English saying:

> "Eat an apple going to bed
> Make the doctor beg his bread."

England, Normandy, Australia, Tasmania and the United States have cultivated the apple by careful selection. In England it is said that there are four or five hundred distinct varieties; and so old is this industry in Britain that it is uncertain whether Roman settlers or monks brought over the indigenous stocks. To monks, at any rate, is credited the beginning of the Norman cider industry. Wycliffe and Chaucer speak of "syder," but long before then a drink was made of fermented apple juice, and people threw apple peel over their heads believing that the initial of the sweetheart could be detected in the fallen peel.

There is a quaint story told in connection with the introduction of the apple into America, and consequently of the foundation of a considerable commerce. The story is engraved upon a tablet in the enclosure built round "the oldest apple-tree in America," standing in front of the chief commissary's office at Vancouver, Washington: "At a lunch-party in London, about 1825, given in honour of some young gentlemen who were about to embark for Fort Vancouver, in the employ of the Hudson's Bay Company, seeds of the fruit eaten were slyly slipped by some young ladies into the waistcoat pockets of the young men, and, upon their arrival at their destination, the young men, in overhauling their wardrobes, discovered the seeds and gave them to Bruce, the gardener at the Fort. Originally there were three trees which grew from these seeds, but the two others have disappeared."

The largest and most profitable orchard in the world is said to have been that of 1600 acres, belonging to the late Frederick Willhouse, of Kansas, who died in 1911. The greatest crop of this apple king's orchard was nearly 80,000 bushels, and it required 200 cars to convey the produce for shipment to the world's markets.

South Australia is now one of the largest exporters of apples for the British markets, and commerce in that fruit is being assiduously pushed forward by the southern Australian states.

. . . .

Among the fruit imports of the United Kingdom oranges form the largest item. From A.D. 1290, when the Queen of Edward I. brought from a Spanish ship "seven oranges," this delicious fruit has been a favourite among British peoples. In 1432 Henry VI., upon his return from France, was welcomed, Lydgate tells us, by a citizen pageant, in which was a grove of "orangis, almondis and pomegarnade." In 1470 *The Paston Letters* mention this fruit, and we find it detailed also among the Court household expenses of Henry VIII. and Mary, and in the records of the Stationers' Company.

Up to this time, however, it was probably the bitter or Seville orange—which possesses a very bitter rind—which was thus bought; for the sweet orange—a native of China—does not seem to have been introduced into Europe until about the sixteenth century, when it was imported by the Portuguese and afterwards brought to England by Sir Walter Raleigh.

The Seville or bitter orange is said to have been introduced from India by the Arabs in the ninth century, first to Egypt and then to Morocco and Spain. Seville had become by the twelfth century its principal home. Its fruit is specially used for making marmalade and its rind for candied peel. The liqueur curaçao is also prepared from the fruit. The sweet orange is borne in great profusion upon an evergreen tree which lives to a great age and is celebrated for its productiveness. There are several varieties of the fruit, of which the blood orange and the St Michael orange are the best known. The pulp of the former is mottled with crimson, hence

its name. That of the latter is very sweet and pale, with a very thin rind and no seeds. A single tree of this species is said to have produced 20,000 oranges.

Although from the sixteenth century onwards oranges have been regarded as a notable article of commerce, London was frequently, until the nineteenth century, without a supply of this fruit for three or four weeks during winter. There was not a steamer devoted exclusively to the orange trade before the middle of the nineteenth century; and, according to Stowe, Billingsgate was at one time the principal quay for landing this commodity. To-day England receives consignments of oranges from many countries, but principally from the West Indies, Jaffa, Florida, California and Australia. South Australia in particular during recent years has taken no small share of the London market. That colony, in 1903, startled the trade by the magnificent fruit she sent to Covent Garden, securing a phenomenal price. Since then Australian exporters have found that if they can land oranges in England between August and the end of the year there is a large demand for their fruit, and South Australia alone now possesses over 200,000 trees.

Among foreign countries Florida, in the United States, pays great attention to commerce in oranges. In the great packing-houses of that state everyone who handles the fruit wears white gloves, to secure it from the slightest scratch or bruise by the finger-nail. The wicker baskets of the white-gloved pickers are lined with thick canvas, stretched four or five inches from the bottom of the basket. The fruit is clipped—not pulled or picked—from the tree; the stem is left smooth and flush with the surface of the orange, and the fruit is laid—not dropped—into the baskets. These baskets are emptied carefully into the field boxes,

which are never filled above the top. The wagons which take the boxes to the packing-houses are fitted with springs to prevent the fruit from being unduly shaken during transit.

Over the wall of the Florida Citrus Exchange, which directs the packing and shipping of a large part of the crop, is written: "Every doubtful orange is a cull." There the fruit is first graded, then carried down a gentle incline to the washing tank. After the bath, assortment and packing takes place, each orange being wrapped in a square of white paper and on each box a stamp indicating the size of the oranges it contains. An automatic carrier conveys it to the "nailer," a special machine which presses down the cover, nailing it to the heads but leaving the middle loose. Waiting cars, each to hold three hundred boxes, transport the fruit to the railway or markets.

Another fruit for which there is an increasing demand in commerce is the banana.

The banana is one of the curiosities of the fruit kingdom. The plant upon which it grows cannot be called a tree, a bush, a shrub or a vegetable. Though it is sometimes as high as thirty feet, it has no woody fibre, and the bunches of fruit growing on the smaller plants are often heavier than the stalks supporting them. So prolific is this fruit that it is estimated to yield about forty times as much as the potato and over one hundred times as much as wheat. It grows principally in the tropics or sub-tropics, although it is being experimented with as far north as Spain and Syria. In its wild state it is little sought for food, because then there is very little of the luscious pulp about the fruit, the large seeds taking much room in the fruit. As the plant has become more and more cultivated, the seeds have gradually disappeared and the pulp has increased, the

propagation of the cultivated banana, now seedless, being from suckers.

The large, handsome leaves and the freedom of the plant from insects have always made it a favourite with planters for shade purposes for young rubber, cacao and other plants, but now it is cultivated and grown for its fruit alone, which is increasing in popularity. Certainly it is one of the most nourishing of fruits.

The old-established and perhaps best-known variety of the banana is the China or Canary banana. Originally discovered and cultivated in China, it is known and grown now in many countries, but especially in Madeira and the Canary Islands, from which most of our supplies come. More recently another variety, the Jamaica banana, which is larger and with a thicker skin, has been introduced to Europe, principally through the energies of a large shipping firm which has the carrying monopoly and also owns large estates in the West Indies for the special cultivation of this fruit. The annual trade in this kind of banana is considerably more in value than £1,000,000 sterling, the bulk of it being with the United States.

While the China banana plant is only about five or six feet high, the Jamaica banana plant reaches twelve feet. While also both kinds of fruit are cut before they are ripe, the China banana is more carefully dealt with in export, being carefully wrapped in cotton-wool and dry banana leaves and packed in open-sided crates. The bunches of the Jamaica banana are placed loose in specially fitted rooms on the West India steamers. Last but not least in the commercial romance of the banana is the unloading at dock of the ripe fruit. Lines of men are formed from each open hatchway to the rail of the vessel, for the bunches are so delicate that they must be handled with care. As the bunches are passed

up they are rested upon mattresses or large cushions. As many as 200 men are sometimes employed thus upon one vessel, and four hours is the maximum time for clearing out, say, 25,000 bunches. When the vessel is unloaded men with rubber boots shovel together the smashed refuse and throw it away. Then the decks and sides are scraped and the hold scalded by steam.

CHAPTER XV

CATTLE AND LEATHER

COMMERCE in cattle dates back to prehistoric ages. Long after people became civilised and prosperous, however, their wealth was measured by the quantity of cattle they possessed. Cattle were used as money by the Greeks. The Homeric shields cost, we are told, some nine oxen, some one hundred. Even when coin was introduced the ox was stamped upon them. We speak to-day of a man's "chattels," meaning thereby that part of a man's property which has no life; but the word originally stood for "live stock" and was spelt "cattle" or catel. Even the Latin word *pecunia*, meaning money, is derived from the older *pecus*, the equivalent for "cattle."

In commercial use the word cattle is generally limited to the varieties of the ox and its congeners, but even with that limitation it is impossible to overestimate the value of cattle in commerce, or indeed the service rendered by these animals to mankind. In recognition probably of this service many ancient peoples held cattle in great veneration. They are represented among the Egyptian gods in the person of Apis; the children of Israel frequently turned to the worship of the Golden Calf and of Moloch; and the cow is still sacred to the Hindus and other peoples of the East; while the bull figures in our zodiac. Alive, cattle ploughed for the people their lands, reaped their harvests, carried them and their goods, guarded their

property, sometimes fought for their homes or even their amusement, and were always an exchangeable commodity, while the udders of the cow yielded at all times a copious supply of milk. To more modern peoples dead cattle are almost as valuable in commerce as the living were to the ancients. Their flesh forms a principal source of animal food; their bones are ground into manure, or turned into useful or ornamental articles; their skin is made into leather; their ears and hoofs into glue, and, in the case of calves, into jelly; their hair is mixed with mortar and their horns are used for all sorts of articles.

Of the two principal groups of cattle, the "humped" and the "straight-backed," the home of the former is in India, where they were apparently domesticated from the very earliest times, as they appear on their sculpture of remote antiquity. They are also found, however, in Africa and Japan, and they appear on the ancient Egyptian monuments of a period about 200 B.C. The Hindus believe that cattle were the first animals created, and they are forbidden to kill them in any circumstances. Neither Hindus nor Jews were allowed to muzzle the ox when treading the corn. The Egyptians might not kill the cow except in sacrifice, but bull-fighting was permitted.

This last sentence may surprise many who may not know that bull-fighting dates back many thousand years before Christ. Pictorial sculpture at Beni Hassan and Thebes shows us that the Egyptians pitted bulls against each other for sport. Strabo tells us that bulls were trained for the occasion, and that the fights took place in the avenues to the temples. Three hundred years before Christ these bull-fights were also a sport of the Thessalonians, and men were pitted against the bulls.

Witnessing these encounters there, Julius Cæsar is said to have introduced them into Rome about 45 B.C. Introduced into Spain by the Moors, bull-fighting has remained the principal pastime of that country, in spite of the Pope's denunciations. The breeding of the bulls is specially carried on in Navarre, Castile and Andalusia, and a good five-year-old bull for the fighting ring costs from £80 to £120 sterling.

Cattle, however, have a far greater value for useful purposes than for sport, and the "straight-backed" cattle are even more important commercially than the "humped."

Of the straight-backed group there are many varieties. Hungarian oxen are particularly noted for their great size and enormous horns. The Friesland cattle, introduced into Spain, are the progenitors, strange to say, of the herds of wild cattle now roaming over the South American continent, seven cows and one bull having been taken from Andalusia to Paraguay in 1556. This is interesting as illustrating the wonderful prolific power of cattle and consequently their great value as a commercial commodity. The English breeds are generally grouped into three classes: polled cattle, shorthorned cattle and longhorned cattle. The last-named are usually white and red and occupy the more fertile parts of the country, but the shorthorned are more in repute, although when crossed with Scotch and Irish breeds the Leicester longhorns are said to make a very valuable type of cattle. The principal Irish breed is represented by the Kerry cow, and the Scotch breeds by the "Ayrshire," "West Highland," "Shetland," "Galloway" and "Angus" breeds. Nor must the Devon, Sussex and Hereford breeds be forgotten among English types. The Saxons were always breeders of cattle, but the Normans would not soil their hands in such pursuits,

although they were great meat-eaters. Thus all our domestic animals when living are still known to us by their Saxon names, but when dead by the Norman names.

Cattle-breeding is not only an important industry here, in Europe; it is carried on upon a vaster scale in Australia, New Zealand, Argentine, the United States and other parts of America; and the cattle ranch is the scene of many another romance besides that of commerce.

While in the Wild West, however, cattle are valued rather for their hides and skins, in more civilised parts, and in the East, they are valued principally for their meat. Cattle flesh is the most nutritious of meat, and when good has a firm texture, an open grain, a rich red colour and a clear, uniform fat. South Australia has given special attention to cattle-breeding and has choice selections of Jersey cows and shorthorns. Their animals frequently weigh over 1200 lbs. and a ready market is obtainable for their young bulls, for one of which New Zealand recently paid the sum of 500 guineas.

One can understand, therefore, that cattle-breeders stand to lose fortunes by cattle disease. Murrain or plague among cattle has always been regarded as a great calamity. The Bible mentions it as one of the worst of the ten plagues of Egypt. A similar catastrophe was the visitation in Hungary in 1711, spreading to other countries and destroying, during three years, 1,500,000 cattle. England and the west of Europe were also affected between 1745 and 1756, losing 3,000,000 cattle, while a similar plague which broke out near London in 1865 caused a Royal Commission of Inquiry upon the subject and the Amendment of the Cattle Contagious Diseases Act.

In Africa the greatest set-back to cattle-rearing has

been the tsetse fly. In some parts of West and Central Africa, for example, where this fly breeds, no cattle can be reared. Rhodesia, which is fast becoming a cattle-breeding country, is troubled with the pest, because, though it seldom breeds there, it infects animals coming across the border from areas which it inhabits.

Cattle are also commercially useful for leather. The aborigine enveloped himself in skins. Later, when he learnt the art of tanning, he converted the skin into leather. As he became more civilised he substituted wool and cotton for garments, but still clung to skin caps and leather boots. In his wealthier days of civilisation, however, when sport and motors become his joy in life, he returns to leather for his coats, his jackets, his trousers and many an article of luxury.

One species of cattle the hides and tongues of which were specially sought a few years ago was the American buffalo or bison. He is almost extinct now. In 1850 there were about 40,000,000 of these animals in the United States alone, and they roamed over a third of North America. But between then and 1883 more than 250,000,000 were slain, and in 1882 200,000 hides were shipped. In 1890 steps were taken to save it from extinction. The largest buffalo herd in the world is now owned by Canada, and is kept in a national reserve near Edmonton. For two and a half dollars per head the professional hunter used to hunt the buffalo for large firms. The African buffalo is a far more difficult animal to secure, and huge sums have been offered for specimens.

The conversion of hides and skins into leather is effected by the action of certain vegetable products called tanning materials, which contain a peculiar compound known as tannin, having the property of combining with the substance of hide and skin, forming

leather, thereby converting a material which readily decays into one which is resistant. Tannin is found in all parts of plants, but it appears to be most secreted in the bark of the stem or root, the rind or husk of the fruit, or the heartwood. A tanning agent should contain at least 10 per cent. of tannin, also non-tannin extractive matter, and be free from dark or undesirable colouring matters.

A method, however, has been devised for the utilisation of such materials as oak wood and chestnut wood, which contains only 3 or 4 per cent. This consists in concentrating the extract till it solidifies.

In this way "tanning extracts" containing as much as 30 per cent. of tannin may be obtained from oak wood. At the present time practically all important tanning materials can be bought in the form of extracts. These extracts are mostly made where the tanning materials are produced.

The exporter therefore pays transport charges only on the material actually used by the tanner, and can use the waste matter left after extraction as fuel and in other ways.

Oak bark was at one time practically the only tanning material used in the United Kingdom for heavy leathers, but of recent years its use, though still very large, has become more restricted, owing to the fact that the bark is expensive as a tanning agent and cannot compete in price with many materials of exotic origin now available.

White birch bark is employed on a considerable scale in Russia. This bark contains about 10 per cent. of tannin, and in addition a small quantity of a pleasant-smelling volatile oil, which is absorbed by hide. It is to the presence of this oil that the characteristic fragrant odour of "Russia" leather is due. Birch bark produces

a soft, light-coloured leather specially suitable for the "uppers" of boots and shoes.

The hides and skins of cattle, however, form but a small portion of those which are utilised commercially in the huge demand for leather.

The porpoise leather of commerce in the United Kingdom is, for example, made from the skin of the beluga or white whale, which attains an average length of fourteen feet, and a circumference of about ten to twelve feet. It is found chiefly along the coasts of Northern Europe, and to a less extent in the Gulf of St Lawrence, and off the coast of Newfoundland, etc.

The fishery is carried on principally by vessels from Dundee, and from ports of Norway and Sweden. About 6000 white whales are taken annually. In preparing porpoise hides the flippers and the dorsal fin are removed, and the skin and blubber cut along the middle of the back and abdomen, from the nose to the flukes, the whole being peeled off in two parts. The blubber is shaved off and kept for oil extraction, while the hides are salted for transport. Most of the beluga skins are tanned in Dundee or Glasgow. Porpoise tanning in the United States is carried on principally at Newark, New Jersey. Porpoise leather possesses great tensile strength, and for this reason is particularly suited to the manufacture of machinery belts. It is also largely used for leather shoe-laces, on account of its strength and durability.

Alligator and crocodile leathers are used for the manufacture of fancy articles, such as bags, slippers, belts, card-cases, etc. Nearly all this leather is prepared from the skin of the American alligator. The skin is removed by cutting through the scaly covering, from the nose to the tail, along either side of the ridge on the back, or in the middle of the under surface. A

cut is then made to the middle of each of the legs, either above or below, according to the position of the primary cut. After cutting round the jaws the skin is removed in one piece. Great care is taken to avoid careless cutting of the membrane, as such cuts show up very distinctly when the skin is tanned and stretched. The skins are then salted and packed in barrels ready for shipment.

Most of the crocodile leather is prepared in the United States, but a considerable amount is now tanned in this country. The process of tanning is similar to that adopted for ordinary hides, but owing to the scaly character of the skin special precautions have to be taken to obtain complete and uniform formation of leather. Skins of sizes from three to five feet are employed, and there is no market for skins from monster alligators ten to fifteen feet in length. The demand for crocodile leather has been met to a large extent by imitations manufactured by stamping other leathers. These imitations possess the characteristic markings of the real skins, and are not readily distinguishable from them, and their successful manufacture is stated to have seriously diminished the market for alligator skins.

Even more valuable is the commerce in hair seals and harp seals for leather. These are not the fur seals, and the hunt for them is far more hazardous. The hunters have to be enduring and adroit, having to cross broken ice-floes in their search for the seals, which are born early in March in large nurseries or "patches" on the ice. The mother seal swims sometimes fifty miles in a day to succour her young, which remain on the floes for a month until able to look after themselves. Half-a-million of these seals are taken annually, and the proceeds divided in shares among the ship-

owners, ice captains and sealers amount to about £250,000 sterling.

At one time the steamers in this fishery were stout wooden vessels; now they are of steel. The crews are made up from tried Newfoundland fishermen. Throughout the sealing season they are packed like sardines aboard the ships, one man to three tons of registered tonnage, and like this they remain for perhaps eight weeks, with ventilation, sanitation and all ordinary comforts at a minimum, rarely washing, rarely changing clothes, and when the ship is loaded the seals are packed into their quarters, or they lie on the deck day and night, regardless of weather, until the port be reached. Worse still are the dangers which they encounter. When they leave the ship and travel on ice-floes, fog may separate them from the ship. At other times they fall through blow-holes, or their ships are crushed in the ice. Of one great blizzard which overtook the seal-fishers a short time back *The Times* records:

"The survivors tell harrowing stories. Two had brothers die in their arms. Several others saw their comrades perish. Many dead were absolutely frozen into the ice and the bodies had to be chopped out with axes. Others were dead and floating in the water between the ice fragments. One man fell into the water in trying to reach the rescue party. They got him out, but he died within twenty minutes. Several others died between the time the rescuers reached them and before they could be got to the ship. Forty-three bodies were taken off three fragments of ice within a short radius. The rescuers piled the dead in groups on level sheets of ice and planted flags above them for the steamer to collect them.

"Many of the dead men had wandered long distances before they succumbed and they were found in frightful postures, the result of the agonies they had experienced in fighting the cold before death."

"Harp seals" are so called because of a harp or saddle-like mark which occurs on the back of the adult male. Harp seal skins are known in commerce under a variety of trade names, which deserve a brief notice. The "whitecoat" is the skin of the very young seal, covered with white fur. Sometimes these young seals weigh fifty pounds apiece. The skin of the older animal, covered with short, hard hair, is termed a "hair." The name "saddler" is applied to the skin of the adult male, and is so called from the black saddle-like marking on the back. The young hood seal skin is known in trade as a "blue-black," and is chiefly used for the fur, as it is not so suitable for leather. The skin of the adult hood seal is known as a "large pot," and is used for leather, although it is not as good for this purpose as the harp seal skin. The term "cat" is applied to very small skins of any kind of seal, implying that they are no larger than cat skins.

At one time considerable quantities of hair seal skins were shipped from the Falkland Islands. It is estimated by the local authorities that at present about 5000 hair seals could be taken off the islands each year without unduly depleting the rookeries. The Germans when they tried to seize these islands in 1914, and thus enabled the British to gain a glorious naval victory, had commerce in view as well as the strategic value of the islands.

Another valuable leather of commerce comes from the sea-lion. The skin of the sea-lion was formerly considered unfit for tanning purposes, but at the present

time the hide is probably as valuable as the oil. From the skins of the young animals a soft, velvety leather is obtained, and the thicker skins obtained from the old animals when tanned are employed as a substitute for walrus hide leather in preparing the polishing wheels used by metal workers. Sea-lion skins are tanned like seal skins, the only difference in treatment being the longer time taken, because of their greater size and thickness. Much of the sea-lion leather on the market is said to have been made from seal skin. About 100,000 lbs. of walrus hide is used annually. It is a thick, heavy leather, and is principally used in making wheels for use by silversmiths and other metal workers, and for polishing fine metal surfaces. The hide is particularly suitable for this purpose owing to its peculiarly tough grain and to the fact that the open character of its fibre enables it to hold the polishing powder. It is usually cut into solid leather wheels, or a ring of the leather may be fastened to a wooden core suitable for attachment to a revolving head or mandrel. Nearly the whole of the walrus leather used for this purpose is tanned in Great Britain.

Goat and sheep skins are another source of leather in commerce, and much African leather comes from these animals, where they are reared and treated on the spot.

The skins, as received from the native butchers, are at once placed in earthenware pots containing a mixture of wood ashes and water. In some cases the skins are first washed and then placed in ashes for twenty-four hours. The hair is then scraped off with a blunt knife and the cleaned skin is allowed to dry for a day and then placed in a second earthenware pot containing water and the crushed pods of a tree known as " bonni." In some places the sun-dried, unhaired skin is placed

in the "bonni" pot and left there until it is thoroughly tanned through, when it is taken out and dried in the sun. In other parts of Africa the skin is not immersed in an alkaline liquid to facilitate depilation, but pegged out and dried, then placed in a calabash containing water and the powdered pods of an acacia and left there during three days, after which it is removed, pegged out on a board and scraped with a bent knife until all the hair is taken off. The skin is then permitted to dry, and when finished is of a pearly-white colour. In all cases the tanned skin is next oiled by rubbing in either palm oil, ground-nut oil or shea butter, the skin being meanwhile rubbed and pulled by hand until it becomes quite soft, when it is ready for dyeing.

Last, but not least, successful experiments have been made in the preparation of leather from the skins of cod, salmon and other fish. In Egypt, Russia and Siberia this industry is carried on, while in France the skins of frogs and toads are being similarly used.

CHAPTER XVI

COLD STORAGE

STRANGE, is it not, that the old and generally universal knowledge that the effect of cold on flesh was to preserve it and keep it fresh did not attract the attention of scientists until the last century? Even then Charles Tellier, of Paris, to whom the origin of the modern science of cold storage is accredited, had perforce to work in the wilderness, and to sacrifice his entire fortune in the development of his numerous discoveries, before the public recognised his genius and their indebtedness. The International Cold Storage Association opened a public subscription to save him from penury. That was in 1912, when Tellier was eighty-four years of age; but thirty-seven years had elapsed since he sent the first steamer, the *Frigorfique*, with fresh meat to the Rio de la Plata. This vessel had been specially fitted up for cold storage, and maintained a temperature below freezing-point even at the Equator. The experiment was in every respect successful, for the cargo remained quite preserved for three months, and when the vessel returned to Rouen, the port from which it started, it brought from the Rio de la Plata the first consignment of frozen meat that reached Europe from America. To-day, as every schoolboy knows, somewhere about half the meat of all kinds consumed in the United Kingdom is of overseas origin; of beef and mutton by themselves about two-fifths.

Although to Tellier belongs the credit of having

developed the modern science of cold storage, it should not be forgotten that the Romans knew the preservative qualities of ice, for it is on record that they brought to their banquets the dainties of all the known world. We know, too, that they iced their drinks, a custom which was introduced into France in the seventeenth century. A passage in Boileau's Third Satire, *Le Repas Ridicule*, 1664, alludes to this use of ice:

> "J'approuvais tout pourtant de la mine et du geste
> Pensant qu'au moins le vin dut reparer le reste;
> Pour m'en eclaircir donc j'en demand. . . .
> Mais qui l'aurai pensé? pour comble de disgrace,
> Par le chaud qu'il faisait nous n'avions point de glace
> Point de glace, bon Dieu! dane le fort de l'été
> Au mois de Juin!"

It is perhaps a moot point whether the world would have been indebted to Tellier for its frozen meat trade had it not been for the accident of a chill to Francis Bacon, which brought about that philosopher's death in 1626. Macaulay has noted that Francis Bacon, "being near Highgate on a snowy day, left his coach to collect snow, with which he meant to stuff a fowl in order to observe the effect of cold on the preservation of its flesh." In so doing he caught a chill, and died of what is now known as bronchitis. Macaulay adds: "In his last letter that he ever wrote, with fingers which, as he said, could not steadily hold a pen, he did not omit to mention that the experiment of the snow had succeeded very well."

On 11th December 1663 Samuel Pepys made the following entry in his diary:—"Fowl killed in December, Alderman Barker said, he did buy, and, putting into the box under his sledge, did forget to take out to eat till April next, and they then were found there, and were, through the frost, as sweet and fresh and eat as well as when first killed."

Explorers also have told us that they have discovered mammoths preserved in ice—thus rendering their flesh still available for food purposes—from a period probably coeval with the first appearance of man on this globe. With so much data constantly before the eyes of the student of science, it is passing strange that no attempt was made until the last century to turn this knowledge to commercial account.

Cold storage is, briefly, the art of preserving articles of a perishable nature by keeping them in chambers constantly maintained at a low temperature. The cooling of cold-storage chambers, which are rooms efficiently insulated from outside heat by double and, as far as possible, non-conducting walls, is effected on the brine-circulation system, the direct-expansion system and the air-blast system. In the first, brine reduced to a low temperature is passed through pipes and coils placed in the room or chamber to be cooled; in the second, cooled compressed air is allowed to expand in the pipes or coils placed in the chamber; while in the third, air cooled by passing it over pipes conveying cold brine, or by the direct-expansion system, is itself blown through the room or chamber to be cooled.

In the military use of frozen meat the cargoes for importation are frozen hard by a refrigerating machine and packed on board ship in a chamber which is cooled by a similar apparatus. When the meat is properly thawed out it is generally admitted to be as good as all but the best home-produced beef and mutton. Of its keeping quality in properly regulated cold storage an interesting demonstration was recently given in London. A hind-quarter of Australian beef which had been in store for eighteen years was exhibited at Smithfield Market, and, though somewhat faded in appearance, it was found, beneath the surface, to have

By permission of] [*Messrs. J. and E. Hall, Ltd.*

A COLD STORE

Interior of a cold store, in which meat and poultry are kept good and fresh by the use of machine-made cold.

undergone little change, while a chemical analysis proved that it had lost none of its value as food.

How greatly this country is dependent upon importation for its bread is pretty generally understood, but it is not so generally realised that since the introduction of refrigeration and of the methods of cold storage and transportation the consumptive capacity of meat per head of the population has increased to such an extent that we are equally dependent upon lands outside for our meat supply. Another significant fact is that the demand is, and has always been, in excess of the supply.

For many years the United States of America were the principal exporters of frozen meat, and when this supply, for some reason or other that has never been properly accounted for, fell off with amazing suddenness, and created something like a panic in Liverpool prices, the Argentine stepped into the breach. For a time all went well, then the United States appeared in the market as a buyer, which rôle she has ever since filled. Australia has recently shown itself capable of unexpectedly large exports of meat, and with the development of this industry in the island continent the statesmen's dream of a self-supporting British Empire will be within an ace of fulfilment. However, it should not be forgotten that the prices ruling for frozen meat are very high, and that the United Kingdom could do with an appreciable increase in the number of carcases imported every year, if they were obtainable.

This fact notwithstanding, the freezing business of Australia has already attained some magnitude, as can be gathered from the fact that the exports of frozen mutton and lamb from Australia amount to about 100,000,000 lbs., of which about 85,000,000 lbs. were shipped to England.

In Australia sheep for export are handled in large numbers by individuals and firms. In the north, for example, near Rockhampton, Queensland, at Lakes Creek Meat Works, thousands of sheep are annually killed and disposed of for freezing, canning, extracting or boiling, according to quality, and all the offal of the animals—bone, hoof, blood, etc.—is made full use of. In this case the company that carries on the business buys the sheep and cattle, and slaughters, treats and distributes on its own account and for its own behoof. At Geelong, Victoria, on the other hand, the Harbour Trust Commissioners of the city undertake the slaughtering and freezing of sheep for those who may make consignments to them, at a charge of 1s. 3d. each for sheep and 11d. for lambs, which charge includes freezing, bagging, twenty-one days' cold storage and delivery to the ship. The total cost of delivering frozen meat to London from Australia works out at about 1½d. per lb.

The prices paid in Sydney to farmers for lambs vary with the London market, but in round figures may be said to average about 10s. 6d. This, of course, does not take into account the distance of the farm from the market, and the price the breeder would actually receive is so much less in proportion.

From the Argentine we receive our largest consignments of frozen beef, but America is a strong and wealthy competitor, and indications are not lacking that in the near future other large tracts of the world's undeveloped surface will have to be given over to cattle-raising, although, of course, the expansion of production cannot be very rapidly effected.

Two important factors in modern times have given a great impetus to the cold storage commerce.

The first and perhaps the most permanent factor is

the extension of the white man's colonies and enterprise in the tropics, where the increasing number of residential Europeans necessitates an extension of the meat supply, and where the exigencies of the climate call for cold storage of such supply. Before the Great World War the Germans had established and were doing good business in refrigerators and cold storage, and there is ample scope for greater development in the tropical part of the globe.

The second factor is to be found in the requirements of modern warfare. As *The Times* remarks:

"The development of the frozen meat trade has greatly diminished the problem of provisioning with fresh meat the immense armies that are now put into the field of warfare. In former times troops on active service were followed in the rear by thousands of cattle on the hoof. To hold, feed and keep the herds in good condition proved a task impossible to accomplish with any degree of success. The cattle were decimated by contagious diseases, and those which survived the plague shrank to skeletons for want of proper forage. Now, though the operation of feeding an army in the field has enormously increased in magnitude, it is carried through with order and economy."

In the Great World War the control of the cold storage commerce played a great part. The British Government practically secured the whole of the frozen meat section of the Argentine meat trade. The trade, it should be explained, has two branches—chilled and frozen.

The term "chilled" is applied to beef which, being carried at a not very low temperature, arrives here in a soft condition, ready for immediate consumption. "Frozen beef" is carried at so low a temperature that

it arrives perfectly hard and requires to be thawed out before it can be used. Mutton and lamb are always imported in a frozen condition.

At the outbreak of the war there was a dead-lock in this trade owing to the precarious financial position in South America, so much so, indeed, that for several weeks no meat was shipped from the River Plate. Then the British Government came to an arrangement for the purchase from the Argentine companies collectively of immense quantities of frozen meat. Not only was the export trade of the republic thereby revived, but the output of chilled beef was greatly curtailed in favour of the production of frozen beef.

The French Government also bought vast stores of frozen meat for their armies. Before the war France kept out frozen meat for the protection of her farmers. The import duties and sanitary restrictions by which that object was realised were removed and free admission was given to foreign meat, not only to supply military requirements, but also for civil consumption, so as to protect the native flocks and herds from undue depletion.

Commenting upon the effects of the war upon this commerce, Messrs W. Weddell & Company, the great authorities on cold storage, state :

"With no previous experience of war conditions, the successful manner in which it has emerged from this first great testing time speaks well for the soundness of the foundations upon which it has been raised. In face of hostile operations on every one of the long ocean routes by which the supplies reach this country; despite the temporary withdrawal of many of the largest refrigerating steamers from the trade for transport purposes; notwithstanding the financial crisis in

South America, which, for a time, was more threatening even than the war risks of the voyage; in spite of the temporary unsettlement of trading values at the outbreak of the war and the sudden diversion of stocks into entirely new channels of distribution, the frozen-meat trade as a whole kept on its way triumphantly."

The carrying part of this great trade is in the hands of British shipowners. There are now over 200 modern refrigerated steamers engaged in this cold storage commerce and the world's export of frozen and chilled meat is estimated at about 1,000,000 tons.

CHAPTER XVII

VEGETABLE OILS

OILS, fats and greases are about the last things in the world to suggest a flavour of romance. But nature is full of surprises. Just as some of the dirtiest and ugliest of animals yield the most delicate and appetising flesh, so some of the greasiest of oils comes from the most tasteful fruit. Further, some of the greatest romances of commercial enterprise have sprung from the handling and utilisation of oils, fats and greases; and a commercial conflict, almost as formidable and relentless as the Great European War, has waged—and is not yet ended—for the control of the raw material.

The rise and expansion of one commercial firm alone, Messrs Lever Brothers, in itself is a volume of romance, in which the journey of Lord Leverhulme and the late Lady Lever down the Congo and through the vast area of tropical palms acquired by the company is only one interesting chapter. Still more varied and instructive are the stories (1) of the Wcst African palm oil trade, (2) of the transition of the coco-nut from use as a mere fruit to the manufacture of soap and candles, and from thence to a butter substitute, and (3) of the discoveries of new oil-yielding trees and fruits.

The oil palm, which is indigenous to West Africa, is found generally throughout that country from the seaboard towards the interior, diminishing in those districts where the climate becomes drier or where rocky and mountainous tracts intervene. It is rarely found be-

yond 200 miles from the coast. The most suitable situation is where the soil is generally moist. Swampy, ill-drained land is not favourable. In those parts of the country where there is gravelly laterite over a deep substratum of syenite, palm-trees may abound in considerable numbers, but the trunks of such trees do not acquire the same thickness as those growing in damper or lighter ground. No distinct varieties are recognised by the natives, although distinctive names are applied to the same fruit in different stages of development. Yet there is great disparity between oil palms, both in yield and quality, to the extent of 30 per cent. The oil palm does not thrive in heavy forest, but in open valleys with low undergrowth. The seeds or nuts, which are large and heavy, are distributed by the agency of birds and mammals.

The full-grown oil palm attains a height of about sixty feet and consists of a stem covered throughout its length with the bases of dead leaves, and bearing at the apex a crown of large, pinnate leaves, each of which may be fifteen feet in length, with leaflets two or three feet long.

The tree is very slow-growing, reaching a height of from six to nine inches in three years, twelve to eighteen inches in four or five years, eight feet in ten years, thirteen to fourteen feet in fifteen years, and attaining its full height of sixty feet in about one hundred and twenty years.

The fruits are borne in large bunches termed "heads" or "hands," which are small and numerous when the tree first begins to bear, from the fourth to the eighth year. In order to prevent their subjects plucking the fruits before they are ripe, or from pilfering the mature nut, the wily native chiefs place a "taboo" on each tree, by affixing "charms" and mystic writing to the trunks.

The general practice among natives in securing the nuts of the oil palm is to climb the trunk of the tree by the aid of a stout creeper, steps up the tree having been previously made by the bases of the leaves cut off in the course of pruning or cleaning. Arrived at the top, say about sixty feet, the boy severs the bunches by an axe, then, descending, collects them in a heap or heaps, covering them with plantain or banana leaves and leaving them exposed to the sun for four or five days. The heat causes the fruit to drop away from the stem and the porcupine thorns which, before, tenaciously held them.

To force the oil from the fibrous pericarp, various methods are adopted. Some ferment; some boil; others do both. Palm oil as prepared by natives from freshly cut fruit for their own use in cooking is a pleasant-smelling and yellow-coloured fat, which is sometimes eaten and relished by Europeans residing in West Africa, but as less care is taken in the preparation of the large quantities of oil required for export, together with the length of time elapsing during transport, it is generally very rancid when it reaches the European market.

Palm oil extracted from the outer fleshy portion of the fruits of the oil palm is also exported in large quantities. The kernels or seeds contained in the nuts or "stones" of the oil palm are obtained by cracking the nuts by hand or by the aid of a nut-cracking machine after the orange-coloured palm oil has been extracted from the outer pulpy portion of the fruit.

The kernels are exported, and the extraction of the kernel oil is carried out in Europe. Palm kernel oil is white in colour and of rather softer consistence than palm oil. It is largely used in the manufacture of soaps. The best grades can be employed for the preparation of margarine.


Native Climbing for Coconuts


Palm Kernels

There is keen competition in securing the oil and kernels on the west coast of Africa, and the business employs thousands of native traders and hundreds of Europeans.

Liverpool, Hamburg and Marseilles are the great European centres for the palm oil and kernel trade.

At one time a well-known soap manufacturer bought his kernels almost exclusively at Liverpool. Then, obtaining a large trade in South Africa, he conceived the idea of securing concessions of land in West Africa, where the natural raw material grew, and of erecting mills there with the requisite machinery for expressing the oil. This was done in spite of great opposition both by the wholesale kernel trading houses and of the transporting shippers. His great rivals soon followed, and now the struggle for the possession of the raw material is at its height.

Nor is the struggle for the palm oil alone, nor is it limited to the soap merchants.

The soap-making industry, indeed, is dependent upon fats and oils, since these two classes of products are the essential requirements for soap manufacture. Soya bean oil, of which much has lately been heard, has found acceptance in this connection, and indeed has ousted to some extent another oil—namely, cotton seed. But soya-bean oil yields a soap less firm than that obtained from cotton seed oil, though this weakness is removable by the use of tallow when soda soaps are desired. Oils when exposed to the air tend to change—to oxidise; some do so more than others. Those which oxidise quickly are known as "drying oils," those which do not as "non-drying." The former are in demand for soft soap, the latter for hard, soda soaps. Linseed and poppy seed oils are types of the first, cotton seed oil a type of the second. In addition to oils, fats—

animal and vegetable—are requisitioned by the soap-maker for his art. For this purpose copra is in demand, because copra, the air-dried pulp of the coco-nut, contains about 50 per cent. of oil readily convertible into a soap having excellent lathering properties in hard as well as soft water. The oil from copra is largely extracted in this country. The requirement of the soap-maker for fat is cosmopolitan; he may draw on castor oil for making the less expensive varieties of transparent soap, olive oil for Castile soap, cotton seed oil, palm oil or linseed oil for soft soap, or, again, lard, when he wishes to turn out a toilet soap of a high grade, and one possessing a desirable white colour.

Apart from the soap industry, however, vegetable oil is required by the commercial magnates in margarine and butter, also by chemical manufacturers. Every nut from which there can be expressed an adequate quantity of oil is sought with eagerness. The ground nut, which most boys know and love as the "monkey nut," is now exploited for its oil, and the "kamoot" or "lamy" nut, which is found on the banks of West African rivers, the shea butter nut from Nigeria and the more universally known coco-nut have all risen in value and contributed something to the romance of oil.

Of these various nuts the coco-nut deserves special attention.

The coco-nut is essentially a tropical palm. Though it will grow up to 25° north or south latitude, it rarely ripens fruit beyond 15° north or south. As the germination of the seed is not injuriously affected by the immersion of the fruit in sea-water for a considerable period, it is assumed that ocean currents played an important part in dispersing the seed from this region over wide areas prior to the intervention of man. The tree

rarely bears profitably until nearly seven years old, and the fruit itself takes nearly a year to mature.

Although introduced by man to all the warmer coastal regions of the world, the coco-nut has never become truly wild, but is always dependent upon human care to enable it to compete with native vegetation. The trunk has been known to attain a height of one hundred feet and a diameter of eighteen inches, while the leaves are usually fifteen to twenty inches long.

The coco-nut palm is not only one of the handsomest, it is also one of the most valuable of tropical economic plants, its products being of great importance, not only to the natives of the countries in which they are produced, but also to the commercial and manufacturing communities of the world, the price of its fruit having increased more than a hundredfold during the last few years. There are many varieties of the tree, causing differences in habits of growth, periods of maturity and yield—and more markedly in the size, shape and colour of the mature fruits; but, generally speaking, the coco-nut palm is a light-loving species, intolerant of shade, delighting in a maritime climate, where the light is strong and where there is a constant breeze. Essentially a tropical plant, it requires a considerable amount of heat and moisture to attain full development.

An average mean temperature of about 80° F., with little variation throughout the year, is perhaps the most suitable. An average annual rainfall of from sixty to eighty inches is advantageous, but as low a rainfall as forty-five inches, evenly distributed throughout the year, is found sufficient when the palm is growing on fertile, moisture-retaining soils. If less than forty-five inches be received, artificial irrigation becomes necessary, while on poor, sandy soils a rainfall of not less than seventy inches is essential.

The soil best suited to the coco-nut palm is a deep and fertile sandy loam, such as is found in alluvial flats along the sea coast, at the mouths of rivers or in wide river valleys. It is in such situations and on such soils that the coco-nut palm is most commonly found to flourish, but it can be grown inland, especially if situated by the banks of a tidal river, the ebb and flow causing ideal conditions.

The coco-nut is raised from seed nuts taken from matured trees of at least twenty years old. Such nuts must be round, not oblong, and must be picked from the tree in a dry condition or gathered up when fallen. Trees are planted about thirty feet apart each way, or about forty-eight trees per acre, because the roots of the developed palm frequently spread around twenty feet, while they penetrate to a depth of six feet. If the subsoil be sandy, draining and liming is resorted to.

During the first two years coco-nut trees are very carefully attended to, particularly in the matter of moisture, clean weeding and lifting of the ground round the stem to a depth of four inches. Natives in West Africa are very fond of "tapping" the tree to obtain "tembo," or palm wine, and measures have to be taken to prevent this, as it results in scanty bearing and small fruit. The first crop of a tree averages about ten nuts per tree during the seventh year of its age, but it should double this quantity during the next two years, and add from 10 to 15 per cent. in quantity during successive years, until sixty or seventy nuts are totalled.

In tropical countries where the coco-nut palm is grown almost every part of the tree from the root upwards is utilised by the natives. The author has known West African medicine-men to use the roots as an astringent, and he has seen Kroo boys on the

steamers using the natural husk, cut into pieces, as a scrubber.

The principal commercial uses of the coco-nut palm, however, lie in the oil which is expressed from its fruit, either on the spot—in which case it is known as coco-nut oil—or in Europe—when it is called copra oil, because the sun-dried or kiln-dried strips of the coco-nut kernel, called "copra," "coprah" or "copperah," are imported into Europe in bags. Liverpool, Marseilles and Hamburg are the chief ports for landing this product of commerce.

But both to procure the oil and the copra the fruit has to be collected and the nut must be hulled.

The removal of the outer fibrous husk of the coco-nut, known as hulling, is effected by striking the fruit on the pointed end of an iron bar or piece of hard wood fixed firmly in the ground. A sharp blow, followed by a dexterous twist, loosens the tough, fibrous material, which is then easily removed. One native can hull about 1000 nuts a day. On modern estates machines capable of decorticating about 500 to 1000 nuts per hour are now employed.

The natives prepare coco-nut oil by primitive methods, some cutting the kernel in small pieces and exposing these in heaps to the sun, when the oil melts and runs off, others crushing the kernels to pulp in wooden mortars and placing the pulp in perforated wooden vessels in the sun, the oil which exudes being collected.

A simple but more efficient method consists in first drying the kernels either in the sun or over a fire, pounding the dried material and pressing in wooden presses. Oil of good quality is also obtained by throwing the pounded kernels into boiling water and skimming off the oil as it rises to the surface.

Coco-nut oil first became known in Europe in the

eighteenth century, but not until the middle of last century was its commercial value as a soap-making oil recognised.

In the manufacture of edible fats its use is more recent.

Fresh kernels contain only about 30 to 40 per cent. of oil, whilst copra contains a greater quantity, depending on the thoroughness with which it has been dried; thus sun-dried kernels contain about 50 per cent. of oil, kiln-dried kernels, 63 to 65 per cent., hot-air-dried copra as much as 74 per cent. The copra is ground and the meal expressed twice, at a temperature of 55° to 60° C.

Coco-nut oil is, in Europe, a solid white fat, but it is a liquid oil at the high temperature prevailing in the tropical countries where it is mostly prepared; it is therefore generally termed "oil" and not "fat."

It has a pleasant taste and the peculiar, not unpleasant odour characteristic of the coco-nut.

Coco-nut oil closely resembles palm kernel oil in appearance and composition, and when carefully prepared does not turn rancid rapidly; but prepared in the tropics by primitive methods, or in Europe from copra of poor quality, it contains not only free, fatty acid, but also other products, probably formed by the action of fungi on the kernels, which give the oil an unpleasant taste.

Coco-nut oil of high grade, or even oil from the highest grades of copra, is now employed in very large quantities in the preparation of vegetable butters. To render it suitable for this purpose the free, fatty acids and substances of unpleasant odours are eliminated, and a portion of the liquid glycerides is frequently removed by expression, the object being to prepare a fat of firmer consistency and higher melting-point.

The "olein" which is removed is employed in soap manufacture.

Coco-nut "stearin" of varying melting-points can be prepared by removing from 50 to 80 per cent. of olein, and when taken from high-grade oil the "stearin" is employed as a chocolate fat as a substitute for the more expensive cocoa butter derived from the cocoa beans. Coco-nut "stearin" from oils of lower grade (copra oils) is used for candle and night-light manufacture, the olein being made into soap.

Industrial chemists on the Continent have succeeded in effecting the entire elimination of the clinging coco-nut taste peculiar to the oil and of the tendency to sour rapidly. By these discoveries the use of coco-nut oil has been made possible in pharmaceutical compounds, such as ointments, pomades and the like, in place of animal fats, whereas before the new processes were known chemists deemed its use dangerous in view of its proneness to rancidity. It is now found upon the dining-table in the form of salad oil. The white "cream" of chocolate creams, too, is often to-day made of coco-nut oil. It has been found almost as effective in pulmonary and kindred ailments as cod liver oil, being at the same time far easier to administer and to assimilate, while decidedly more palatable.

More important still are the new uses to which the oil is now put. The first of these is coco-nut lard, which became an accomplished fact almost immediately upon the discovery of the new processes referred to and which is to-day manufactured on a very extensive scale. So similar is it in appearance and general properties to the animal product that it is difficult to detect any difference between the two. In place of doubtful animal fats, coco-nut oil is almost exclusively used for margarine and produce.

Before the discovery of the processes referred to, £12 per ton was the price for average quality copra; to-day it is almost double, while top-quality copra is even higher. Coco-nut oil was then bought and sold at, roughly, £18. It is double to-day, even allowing for the war rise. In other words, the normal market prices of both articles may be said to have increased by approximately 100 per cent. The old uses for the oil in the manufacture of soap and candles still continue. Every year millions upon millions of nuts are still desiccated, ground up and sold for flavouring purposes in the confectionery and culinary arts, so that the newer and more important uses do not displace the older uses. Not many years ago £2 per thousand was a good sale price for coco-nuts, whereas recently £5 has been obtained. The annual consumption of copra in Europe alone is now about 2,000,000 tons.

Germany and Holland, even before the Great World War of 1914-1918, were great importers of copra, and the Germans were among the principal pioneers of the industry on the west coast of Africa, as well as exploiters of all kinds of vegetable oils to be expressed from tropical nuts. When the war broke out it was discovered that Holland alone was importing in one month nearly 12,000 tons of "nuts and kernels for expressing oil therefrom," while in the corresponding month of the previous year less than 2000 tons had been bought in that country. As much of this new import was believed to be reimported into Germany, Great Britain prohibited the export of copra.

CHAPTER XVIII

MINERAL OIL

OIL, boys, oil! They've struck oil to-night! Only those who have witnessed the scenes which take place on a race-course when the favourite has won, or in a footballing centre on "Cup Tie" night, can picture the joy and excitement in a far-off district when this shout is raised among miners, engineers and speculators, all seeking mineral oil from the bowels of the earth.

There are many such oils, but the most important are bitumen, shale and petroleum, which are all closely allied to each other.

Bitumen, or asphaltum, as the ancients called it, the latter word being Phœnician in origin, is, to use Lyell's description, "mineral pitch of which the tar-like substance often seen to ooze out of good coal when on fire, and which makes it cake, is a good example."

It is brownish-black or black in colour, melts at 90° to 100° C., burns with a bright flame, and may be dissolved either in whole or part in oil of turpentine, ether or alcohol. It contains about 80 per cent. of carbon and 9 of hydrogen, the remainder nitrogen, oxygen and ash.

Most of the asphaltum or bitumen of antiquity was brought from the Dead Sea—one of the gloomiest places in the world—and is still found there, and also near the Tigris and in the Caucasus. In ancient times it is mentioned as having been found at Hit, above Babylon, on the Euphrates, and it is believed to

have been the "slime" or pitch mentioned in the Bible as having been employed in the building of the Tower of Babel, and for daubing the ark of bulrushes in which Moses was placed, and there are other references to the "slime-pits of Siddim," which is the region of the Dead Sea.

The Egyptians used this bitumen or asphalt for embalming their dead, and in Arabia, Egypt and Persia to-day solid asphalt is used instead of pitch for ships, while the asphaltum fluid is used for varnishing and for burning in lamps, besides covering roads and pavements.

Most of the asphalt used for London streets is not natural asphalt, but an artificial manufacture from pitch, bitumen and gravel, or from a brown limestone found by the Jura Mountains.

Bitumen is also found in Europe in the island of Zante, in Albania, Dalmatia, Carinthia, Germany, France, Switzerland and in small quantities in Derbyshire, Flintshire, Cornwall, Galway and Shropshire. In Dalmatia the limestone is so bituminous that it can be cut like soap. The walls of houses are built of it, and then set on fire, when the bitumen burns out and the stone becomes white; then the roof is put on and the house completed.

The New World can also boast considerable quantities in Peru, California and Trinidad.

The Trinidad bituminous lakes are remarkable. Sir Charles Lyell called attention to the island of Trinidad, where "fluid bitumen is seen to ooze from the bottom of the sea on both sides of the island," and remarked that according to good authority a spot of land on the west coast of Trinidad suddenly disappeared in 1780 and was replaced by a lake of pitch. Many geologists believe this mineral oil to have a vegetable

origin. The Orinoco has for ages been rolling vegetable matter into the adjacent ocean, and it is thought that subterranean fires may have converted it into petroleum, which, being forced upward by similar causes, has been inspissated and transformed into varieties of asphaltum.

More recently oil has been extracted from shale, a laminated rock of varying hardness and mineral composition occurring where silt has been deposited and metamorphic action has not subsequently taken place. This shale oil has been distilled in Scotland and Spain. In Scotland from Queensferry to the south-east end of the Pentland Hills, and, again, from the north-east end of the Pentland Hills to Burntisland on the Forth, the chief products of shale are 25 to 30 per cent. of lamp oil and 10 to 20 per cent. of lubricating oil, which distillation yields naphtha 4 per cent., gas oil 10 to 15 per cent. and about the same percentage of paraffin.

In Spain, under the auspices of the New Spanish Oil Company, eleven main subterranean galleries in the brownish hydrocarbonated bituminous clayey limestone of the province of Gerona have been opened to exploit the shale oil and the sulphate of ammonia, a by-product. The extraction of the mineral is carried out by following the mineralised vein-like seams, allowing for drainage, and applying the Delmonte process. The mineral is subsequently conducted to the factory by means of an aerial self-acting cable. By the Delmonte process the shale, instead of being placed in a retort and heated *externally*, is charged continuously into the top of the apparatus, and by passing gas through the material being treated the whole of it is raised to an equal temperature *inside and outside*. By this process even ordinary coal can be made to produce from fourteen

to twenty-five gallons of oil, of which as much as 50 per cent. is motor spirit, and thus our coal-fields may be transformed one day into oil-fields, and the variety of coal known as "cannel"—which is at present a drug on the market, but from which the largest percentage of oil can be obtained—may one day be high again in favour.

The fact that mineral oils can be obtained from so many earth and rock formations has tended towards a general name being found for them, "Petroleum" (from *petra* = a rock, and *oleum* = oil), which is used for a variety of inflammable liquids from faint yellow to blackish in colour. Petroleum spirit proper, however, is that portion of petroleum which distils over between 120° and 170°, with a specific gravity of ·740 to ·745. It does not dissolve resin, and is used for diluting linseed oil varnishes and for cleaning printers' type.

Petroleum ether is that portion which dissolves over at 45° to 60°, with a specific gravity of ·665. Clear and colourless, it is used as an anæsthetic and as a remedy for rheumatism.

Petroleum benzene, again, is that portion which distils over from 70° to 120°, with a specific gravity of ·680 to ·700 and a boiling-point of 60° to 80°. This dissolves turpentine, rubber, fats and oils, and is used for skin diseases and stomachic pains, and in the preparation of varnishes.

The light petroleum oil more commonly known by the name, and used all over the world for illuminating purposes, should have, according to the Petroleum Act, a specific gravity of ·810 to ·820, and should not evolve inflammable vapour until heated to 55°. If an oil gives inflammable vapour below such temperature it is scarcely safe for ordinary use.

The great importance of petroleum has been so

realised during recent years that all over the world it is eagerly sought. The world's production is over 50,000,000 metric tons, and is continually increasing. The United States is the greatest exporter, while Russia is second, and Mexico appears to be competing for third place.

Sir Boverton Redwood, Bart., who is the petroleum adviser to the British Admiralty and the Port of London Authority, says:

"The petroleum industry has advanced to a position of great importance, mainly in supplying a cheap, convenient and efficient light, and an excellent lubricant for machinery. During the past few years it has also furnished the motor spirit which drives our automobiles, motor boats, submarines, hydroplanes and aeroplanes. Now, however, it is becoming a great fuel industry, for it is evident that if there is to be any large substitution of oil for coal as a source of power, the output of oil will have to be greatly increased. At present the world's production of petroleum does not amount to much more than 5 per cent. of the output of coal, even allowing for the higher calorific value of the liquid combustible. The general employment of motor spirit has of itself contributed largely to the present profitable character of the business, though its high price has led to the use of distillates of higher specific gravity and lower volatility, of which a far larger percentage can be obtained from the crude oil."

The supply of oil fuel has been a potent factor in state development. It has made the State of Oklahoma abundant in prosperous cities, and has developed the railroads and manufacturing industries of Texas. In Louisiana it has made the sugar industry ready for the free list, and has caused corresponding changes in Illinois and Wyoming.

Oil fuel has completely revolutionised California, so that the state is in the midst of a startlingly rapid transformation from a mining and agricultural community to a manufacturing centre, and the keynote of the Panama Pacific Exposition of 1915 in San Francisco, originally intended to be a tribute to the extension of commerce through the opening of the Panama Canal, really marks the change of San Francisco from a future Liverpool to a future Birmingham.

Not until Dr Diesel evolved his type of engine did the general use of oil fuel as a motive power enter the region of practical possibilities. Dr Diesel when a young man, listening to a lecture on mechanics, conceived the idea of an engine in which, without any previous transforming purpose—such as the conversion of water into steam by coal heat—the heat of the natural fuel should be converted to work the cylinder of the engine itself. For ten years he studied the theory of his engine. For another five years he conducted practical experiments. When his motor was placed on the market he was forty years old. Within the few years it has been in use it has developed enormously. But the developments have all been along the lines of, and in accordance with, the principles laid down by the inventor. The Diesel engine can work with any heavy oil. Men of all nations gladly hailed Rudolph Diesel, of Munich, among the greatest discoverers and benefactors of the time. The Diesel engines and various other internal combustion engines of similar type as first manufactured were of moderate horse-power. By degrees their size and horse-power were increased, until to-day motors of 1250 b.h.p. are being constructed at Kiel, and much larger motors are looming in the near future. Experts talk of the time when

motors of 10,000 horse-power will be a commercial possibility.

But Dr Diesel, like so many other geniuses, has not lived to see the later developments of his invention. Towards the latter end of 1913, while crossing to England to take part in a directors' meeting, he mysteriously disappeared. Two friends with whom he had been chatting pleasantly on board after dinner accompanied him to his cabin and, wishing him "good-night," turned into theirs. The next morning the doctor did not appear at breakfast. It was then discovered that his bunk had not been slept in during the previous night. His body was never found. It is surmised that he returned to the deck for a smoke and walked overboard accidentally.

The use of liquid fuel in place of coal for generating steam power, and even more the advent of the Diesel internal combustion engine, and its gradual but accelerating application to the fleets of war and trade throughout the world, have completely changed the outlook, both commercial and Imperial.

Prices of oil have doubled during the past few years; the need for widening the circle of production for industrial purposes has received much attention elsewhere.

Oil gives increase in speed and in radius of action; there is great saving of time in getting up speed for attack or defence; oil may be stowed, replenished and conveyed to the furnaces with less labour and greater dispatch; bunker space is saved and the fighting efficiency of the personnel increased; heavier armament may be carried and better protected; and, most important of all to us, stocks of fuel can be replenished from tank steamers on the high seas, thus avoiding the necessity of returning to port to refuel. Mr Winston

Churchill, First Lord of the Admiralty, has described how much our own Navy is dependent upon oil. He says:

"In the year 1909 the first flotilla of ocean-going destroyers wholly dependent on oil was created, and since then in each successive year another flotilla of oil-only destroyers has been built. There are now built and building more than a hundred destroyers, including coastal destroyers, which are solely dependent on oil fuel. Similarly during the last few years oil has been employed in coal-burning battleships and cruisers to enable them to realise their full power in an emergency. . . . In the autumn of 1911 there were more than a hundred and fifty vessels built and building which were dependent wholly or partly on oil. . . . We were compelled to use the oil fuel over almost the whole field of the new construction programme of 1912-1913.

"This condition and the reasons which produce it were repeated in 1913-1914. For light cruisers and destroyers oil must be used or they would not be able to discharge their tactical purposes."

To provide for the future the present advisers of the Admiralty suggest as an ultimate policy that it should become the independent owner and producer of its own supplies of liquid fuel: (*a*) by building up an oil reserve; (*b*) by acquiring the power to deal in crude oils as they come cheaply into the market; (*c*) by becoming the owners, or at any rate the controllers, at the source, of at least a portion of the supply of natural oil which is required. The last-named step has already been taken. The British Government now controls, through a majority of shares in a large oil company, vast oil-fields in Persia and Mesopotamia; although with less expense and more safety, perhaps, they might have developed the vast oil-fields *within* the Empire—*e.g.* in India. Some

of the most influential and patriotic of British capitalists also, including some ex-Cabinet ministers, are gaining concessions in oil-bearing territory with the ultimate idea of control of oil outputs in Columbia, Ecuador, Galicia, Venezuela, Bolivia and Mexico, as well as developing the sources of supply in our own colonies or protectorates—*e.g.* Canada, New Zealand, New Brunswick, Nigeria, Newfoundland, Egypt and Trinidad. The competition between American and English capitalists to gain concessions and exploit mineral oil in Mexico is said to have exercised no small influence upon recent civil wars in that country, one group of capitalists indirectly supporting one party, and *vice versa*.

France is entirely dependent on outside sources, although she has shale deposits worth her attention. Russia and the United States have immense tracts of oil-bearing fields within their borders for the maintenance of the oil fuel policy to which they have pinned their faith, and in pursuance of which they have built capital ships and are constructing reserves. Russia before the war had also access to the oil regions of Rumania, which were among the richest in the world, and whose output was advancing at a much increased rate with the application of up-to-date machinery. This development was backed by some of the leading British and foreign oil financial interests, and was being greatly hastened by the laying of a group of pipe-lines to Constanta by the Rumanian Government. The Great European War of 1914-1918 saw the destruction of the Rumanian oil resources, and also the rich oil-fields of Galicia.

The French and Italian navies, like our own, are considerably fed from the tank steamers which load up at that port.

Spain, particularly in the province of Gerona, has some excellent petroliferous formations and bituminous limestones which are being exploited for their oil, as mentioned previously.

In short, the commerce in mineral oil becomes yearly more important, and perhaps in the future it will not be too much to say that the power which is to exercise the greatest sway must not only rule the sea, but rule the oil-fields.

The story of the oil industry in Rumania is illumined by the dramatic destruction of the oil-wells there by the British during the terrible Rumanian retreat in 1917. On the suggestion of Sir Norton Griffiths, acting for the British Government, the whole of the wells and the machinery of British companies were destroyed, the Government to pay the cost.

The destruction of the wells was arranged so that they should not fall into the hands of the enemy, and in a patriotic spirit all the companies complied. It would have been unnatural had they done anything else. Naturally, the Government was willing to pay the cost. That the Rumanian oil industry had assumed enormous proportions is seen in the output figures for the year preceding the outbreak of war. Then 15,000,000 barrels, or nearly 2,250,000 tons, were produced, and then the fields were only on the eve of development, so to speak. Rumania was only at the beginning of her productive career as far as oil is concerned, and it is unfortunate that she has had to begin all over again.

The fight for the control of oil-fields was a particular phase of the Great European War, and the Galician oil-fields in Austria changed hands more than once during the struggle, and marked an important stage each time in the success, now of Russia, and then of Austria. The great efforts of Turkey to capture and

control the Baku and North Persian oil-fields were also a prominent feature of the war, and the presence of those valuable oil-fields in that quarter of the globe played its part in the deliberations of the Armistice and subsequent Peace Congress.

On our side during the war, so depleted were the stocks of naval fuel oil in 1916 that the fleet was obliged to restrict its exercises, and became seriously handicapped in its duties. The total stocks of oil in the country at that time amounted to only 900,000 tons, and it was considered that the absolute minimum for safety was 1,500,000 tons.

At a time when oil-carrying vessels were being destroyed in increasing numbers the idea was conceived of carrying oil in double bottoms of ordinary cargo steamers. This enabled over 1,000,000 tons of fuel oil to be transported in fifteen months and very materially helped to save the situation.

Oil experts have accordingly been looking at home to utilise oil wherever it can be found, and more than one drilling for this commodity is now being made in the British Isles.

CHAPTER XIX

FURS

ON a cold winter day in the West End of London the fashionable women of England's great metropolis may be seen everywhere arrayed in costly furs, black, brown, grey, and white, the value of each of which may be anything from £15 to £5000. Not in England alone, but in all the cool countries of the world, the same sight may be seen; while, in some warm countries, where the wearing of fur would be most uncomfortable, a trimming of fur round a silken robe is often adopted to distinguish royalty.

Far back in the history of man the honoured place of fur is the same. Marco Polo waxed eloquent in describing the rich fur skins of the Khans of Tartary, and the early fathers of the Church waxed equally wroth at the adoption of this "barbaric and debasing luxury" by the wealthier classes of Rome and Byzantium. As the gifts of emperors and kings, as special badges of state functionaries, as the price of redemption of royal captives, furs vied with precious gems from very early times, and their history is stained with the bloodshed of tribal pillage, national wars, ruthless individual struggles and the foundation of empires.

To-day, while as popular as ever as a luxury, fur is also as indispensable a necessity to northern peoples as in the earliest days of its use, when it was used with the pelt or skin as a protection against the cold wind and storm.

The best fur-bearing animals are mostly inhabitants

of the northern regions, the pelt of the leopards, lions, tigers, monkeys and similar tropical animals being used more for rugs and floors than for personal wear. The author, however, has been a frequent witness of the use of baboon and leopard skins as human coverings in religious ceremonies in West Africa.

Among the furs we prize most highly for personal wear are sable, silver fox, black fox, ermine and sea-otter. These come from animals comparatively shy by nature—although the ermine is very destructive—and therefore likely to decrease with an increase of hunting. They live, however, in such inhospitable regions that man will never take up his abode sufficiently near them in such numbers as to scare away or exterminate them. The mink, skunk, musquash, opossum, racoon, which yield us the furs known by their respective names, are, on the other hand, very destructive and depredating animals, yet some are actually domestically reared upon farms to ensure a fur harvest. So incessant, indeed, is the encroachment of Art upon Nature that not the smaller animals only but the larger ones also are taken away from their natural homes and brought up in an artificial atmosphere.

Some of the highest priced silver and black fox skins which are now placed upon the market have been from animals reared in captivity and improved by selective breedings. And so, while the red, the blue and the white foxes of the northern part of North America are still caught by traps rubbed with strong perfumes like assafetida and castoreum, the silver and black skins are now seldom the trophies of sport.

What is the reason ? The fur of this fox has long reigned supreme in popularity and price. All furs have become appreciably scarcer of late years ; but the

great popularity of the black fox would have been an irresistible temptation to extermination unless artificial means had been taken to preserve them. At least twenty years ago the pioneers of the industry began experimenting with the breeding of foxes in captivity. These operations were conducted by them with great secrecy in Prince Edward Island, in the Gulf of St Lawrence, until they had made large fortunes. Then, quite recently, it became publicly known (*a*) that the black fox will undoubtedly breed in captivity, (*b*) that the fur of the domesticated animal is superior to the wild, and (*c*) that the female fox will breed eight or ten times in a lifetime, with an average of five pups to the litter. The knowledge of these facts caused a "boom" in the industry. In Newfoundland the whole world was talking "black fox," and a large amount of capital was put into the business. So great has been the recent demand for breeding purposes that very few fine specimens have been killed, and fox farms have become both popular and profitable institutions in many an Atlantic island.

Turning back to the furs which are derived from more natural sources, we find that commerce in many of the varieties has been bound up with the romance of a nation's history. Take, for example, the expensive and much-prized sable, each hair of which tapers gradually to a point.

It was in June, 1741, that Vitus Bering, a Danish captain in the Russian service, sailed from Kamchatka to reach that portion of the American mainland now known as Alaska. Bering, though he named the straits after himself, was a Court favourite and an incompetent navigator, but one of his lieutenants anchored off the coast and enjoyed some sable hunting. The furs which were brought back excited admiration

and greed among the Russians, and the sable fur trade was forthwith commenced.

The fur traders, or *promishleniki*, sailed the stormy sea in boats thirty feet long and twelve feet broad, with flat-plank bottoms fastened by walrus thongs and caulked with moss. The sails were reindeer skins and the ropes strips of elk skin. In 1779 the Empress Catherine levied tribute on the Alaskans and two years later Ivan Golikoff and Gregory Shilikoff formed a fur association. Several factories were opened and one placed under the care of a Russian sailor named Alexander Baranoff. So able was his conduct of the fur trade that when the Emperor Paul gave the control of Alaska to the company Baranoff became Governor and ruled with a rough hand for twenty-seven years. During a temporary absence the Indians, who had been securing furs in enormous quantities, rebelled, and massacred the Russian sable settlement. But Baranoff returned and took a terrible vengeance.

Now it so happened that the Indians had obtained their weapons in exchange for furs sold to a few straggling English traders who were seeking the Canadian sable, which is not so costly, and also hunting the beaver.

The romance of the beaver fur trade is yet more fascinating to the British race. For while the Russians were seeking fortunes in sable, the beaver beckoned the British to establish the Dominion of Canada.

The Hudson Bay Company began under a charter granted by Charles II. to friends of Prince Rupert, who became the first Governor, and the price asked for the bestowal of miles of this new territory was "two elks and two black beavers." From this sport and industry the Company extended its sway over more than 2,000,000 square miles.

The beaver is noted for its power in felling trees by

means of its chisel-like teeth, one side lower than the other. By felling a tree they dam a stream. The pool thus formed is usually called a "beaver meadow." Near it they erect circular dwellings of logs and stones plastered down with mud, the entrance being on the water side. As a rule they are captured by traps or nets, but sometimes their houses are raided by the hunter. After the process of "unhairing"—that is, the removal of the top or water hairs—the fur is used for collars and cuffs of fur-lined coats.

A little farther west from the haunts of the beaver and the Canadian sable, on the western shores of Alaska, frozen streams may be seen to-day spanned by half-a-dozen poles perched perpendicularly in the ice, below which, hung in the water, is a large net barring the way from shore to shore. Lying on the bank, with spears in their hands and axes at their sides, are some Russians. Just as the sable enticed the Russians and Cossacks from the Black Sea and the Volga across dreary Siberia to the Bering Straits and the Alaska coast, so the sea-otter lures the same venture-some race to-day among the islands, ice and fog-banks.

After hours of patient waiting the otter comes swimming with the stream. His presence is indicated to the trapper by the ringing of a bell suspended from the centre of the rope connecting each pole.

The sea-otter is four to five feet long, excluding the tail, and a fine skin will frequently fetch £200. The colour of this fur is a rich dark brown interspersed with white hairs a little longer than the fur. A curious fact about the sea-otter is that it does not dig its own habitation, but settles in the first hole it finds in the clefts of rock or among piles of floating wood. Its feet have membranes, and it can walk only a little quicker than it can swim.

In the same vicinity, in the islands of St Paul or St George, in Alaska, a dozen or more men may be found, with long poles, hunting the seal to secure the valuable sealskin of commerce. The hunters approach slyly, and run quickly between the surf and dozing "bachelor" seals which have hauled themselves up on land. The seals, startled, scramble on the land, and are driven to the killing grounds in squads of fifty or a hundred, and clubbed. Some seals offer little resistance, but the "bladder" seal often turns upon the hunter.

The Newfoundland seal fishery is more trying than the Alaska seal hunting; but the Newfoundland seal is sought for its oil rather than for fur, and its skin is converted into leather.

In striking contrast to the creatures just mentioned is the Persian lamb, which yields us the Persian lamb fur often miscalled Astrakhan. The "caracul" or Astrakhan lamb is a variety of the Persian animal, but its fur is shorter and less curled, while the skins are smaller and cheaper. The Persian lamb is one of the most ancient breeds of sheep, usually black, but sometimes grey or brown. The pelt taken when very young, while the fur is still short, is known as "broad-tail," and it is usually dyed black, giving it the appearance of watered silk. As one of the best-wearing furs, it is frequently in fashion, because there is little difficulty in joining skins or inserting small pieces. It is also a fur worn by men as well as women.

Another fur worn by both sexes, and upon which great price is set, is the ermine. At one time this fur could be used only by royalty, and it is still used for state robes, and remains one of the furs of heraldry. When seen with black spots instead of tails, this fur is called miniver.

To obtain good furs, they must be taken during the

winter season, for at other times grey hairs are mingled with the white, and are called "grey-back." During summer also, the fur of the ermine or stoat is short and brown. The ermine is only five to ten inches long, excluding the tail, so many have to be killed to produce much fur.

Musquash fur, which is much in demand for motor coats, and, after shearing and dyeing, for imitation sealskin, comes from the musk rat, so called because of the odour exuded from its skin. This inhabitant of Nova Scotia, Labrador, Alaska, Minnesota and the Red River Settlements is from six to twelve inches long, excluding the tail. Like the beaver, he makes his home in circular form by the water, where he is trapped by solitary hunters with steel traps, or shot, or speared. In colour, the musk rat is brown, and he is darker upon the back than the rest of his body.

Another fur which has become in demand through the great increase of motoring is the opossum. A few years before the advent of the motor it was quite out of favour, in spite of its attractive appearance and cheapness.

The opossum is a night animal, between twelve and twenty inches long, exclusive of the tail, frequenting the gum-trees of Australia, or feeding on birds and birds' eggs among American trees. There are many kinds of opossums, some having a pouch in which they carry their young, others being pouchless, and carrying their offspring on their backs twined on the tail of the mother, which is arched over her back for the purpose. The yapock or water-opossum, living on fish, is yet another variety. He lives between Guatemala and Southern Brazil. The pelts of the Tasmanian opossum are larger, and the fur is thicker and longer in the hair, consequently this variety is most valued.

The grey squirrel of Lapland, Russia and Siberia is an extensive article of commerce in connection with the fur it yields, which is popular throughout the world. Squirrel skins are collected as taxes in Siberia. A similar animal in Scotland and Norway yields the valuable "marten" fur varying from light to dark brown of a yellow shade.

The majority of fur-bearing animals, it will have been noticed, are trapped or snared, weapons being avoided lest the coat be damaged. Easy though it may seem to catch animals in this way, the trapper's life is a weary and often a disappointed one. Many hours in an uncongenial climate have to be spent in preparing traps and bait, and many a wait has to be endured. Even then, when the trapper arrives to collect his quarry, it has often disappeared, devoured by a wilder animal of prey than man.

Once captured, the skins have to be removed as quickly as possible, lightly tacked out, pelt outwards, and allowed to dry in a hut or warm place, but not near a fire. The skin of the leopard, tiger, monkey or other tropical animal has also to be treated with acid. The sealskin is pickled in brine.

The finest furs are undoubtedly those which come from the Arctic regions, and they are best when obtained from animals killed during the coldest period of the year.

Another interesting feature about fur-bearing animals is that those feeding in the water have their finest but shorter fur on the under portions of their body and the longer fur on their backs, while the reverse is found in those feeding upon land. But fickle is the fashion in furs. And of this a good story is told in connection with the mink fur. A dealer who firmly believed in this fur bought up pelts in 1860

at two sovereigns apiece. The demand diminished; still he bought. Mink then went right out of fashion, and he bought on, obtaining skins at a shilling each. Six thousand of these he carefully stored. Within twenty years mink came again into fashion and he cleared at a profit of £5000.

The bulk of the fine furs of the world is brought to London, where less than a dozen brokers sort, catalogue and sell them at public auctions. Such sales of general furs take place in January and March, and smaller sales in June and October; but sealskins are sold separately in December. Numerous buyers from Russia, America and other countries attend these sales, but large consignments of fur skins are also sent direct to other cities of the Continent, notably Nijni-Novgorod—where perhaps is held the greatest and most interesting of all the fairs in the world—Leipzig, and Irbit, Ishim and Kiakhta in Siberia. Persian and Astrakhan, ermine and Russian squirrel furs are bought almost exclusively at the Russian fairs, Kiakhta being the great mart for ermine and Chinese furs, Ishim for the Russian squirrel, and Nijni-Novgorod for Persian and Astrakhan.

Of the darker kinds of fur, the fullest and darkest is the most valuable, while in the bluish-grey or white varieties the clearer and brighter are most prized.

A visit to the public fur auction at College Hill and the warehouses around is full of interest. In the warehouses is stored the bulk of the skins which are offered for sale, for in the auction room itself only a few skins may be seen. Each floor of such a warehouse is packed with skins from floor to ceiling; and although science has succeeded, perhaps, in deodorising individual skins, when assembled in the aggregate they are far from being odourless.

Those accustomed to the atmosphere appear not to notice it ; but it is unmistakable to the visitor. In a corner, protruding from some skin, may be seen a yellow or a black foot with large claws. Upon hooks around the racks are " sale bundles " of musquash, skunk and other varieties, samples by which the buyers gauge the value of the lots to be offered in the auction room. More costly varieties like the sable can be seen in the " lot," but the cheaper ones only in " sample." All the employees, as well as the buyers—and the visitors also, if they be wise—are clothed in long white linen coats; otherwise one presents a spectacle upon returning to the street.

In the auction room about a hundred buyers from various countries sit upon the curved tiers of seats facing the rostrum. The bidding is rapid, the lots varying from one silver fox perhaps to six or more sables, a few hundred skunk or a few thousand musquash. The bids are usually in shillings, and prices vary widely for the same kind of skin. A skunk may fetch a few shillings or a sovereign or more, while a silver fox may go for £50 or £500. Altogether, at the spring sales alone, some 10,000,000 or 12,000,000 skins are annually sold here. Of these about 5,000,000 are musquash. Next in demand are skunk, racoon, opossum and fox. Seal, sable, mink, otter, beaver and chinchilla are, of course, always sought, and are more valuable, but they are not always " in fashion." And when, besides these, we notice, amid a huge array of furs from innumerable beasts of prey, some 30,000 or 40,000 skins of the domestic cat, a tear perhaps bedims the eye, as we fondly remember the unsolved disappearance of a favourite " Tabby " and reflect that she too may be playing a part in the romance of fur.

CHAPTER XX

FEATHERS

FEATHERS are the plumes or quills of birds, the former generally diffused, and the latter on the wings or tails. All feathers have considerable strength, and while they are being renewed once or twice a year, the bird is languid and weak, its strength as well as its beauty returning with the renewed feathers.

In most of the uses to which feathers are put, both the shafts and the feathers attaching are employed; but when required for stuffing purposes the shafts have to be properly treated, or they would pierce any covering into which they might be placed, and the barbs are therefore stripped or cut from the feathers. In any case, they, as well as the feathers, undergo a careful process of drying and cleaning, otherwise they would attract damp, harbour vermin and become smelly. The drying is performed in highly heated rooms or stoves, and the feathers are subsequently beaten with a stick, and shaken in a sieve to eliminate the dust and other impurities.

The French work feathers into artificial flower bouquets, imitation butterflies and similar artistic work; and another people equally skilful in this direction are the Chinese.

Feathers are commercially valuable in many ways, but their chief uses are for beds and upholstery, for ornament, especially among ladies, and for quills in writing purposes.

FEATHERS

Those used for beds and upholstery must be light, elastic and free from matting and softness. Goose feathers are particularly useful for these reasons, and, when plucked in spring from the living bird, are more elastic and less liable to taint than those from dead geese. The down of the eider duck is also light, soft and elastic, but it has some tendency to mat, and is therefore used mostly for quilts and for articles of clothing, the feathers of ordinary ducks, swans and other aquatic birds being principally used for stuffing beds.

The eider-down is the soft and elastic down of the eider or Cuthbert duck, a species found in the Arctic regions, and extending south as far as the Fern Islands off the coast of Northumberland, where it breeds. The forehead and crown are blue, the hind head, nape and temples green, and the rest of the body variegated with white, black, buff and greenish-yellow.

In the stuffing of beds the feathers of the domestic fowl are sometimes used, but they are harsher and less downy than those of aquatic birds. Feather brushes and dusters are also made from the wing feathers of the fowl.

The use of quill feathers for writing dates back to the sixth century. From that time until steel pens were invented, in the early part of the nineteenth century, quill pens were the principal writing implements of civilised peoples. Such quills were and are obtained from the goose, crow, swan, turkey, and even from the eagle and hawk, though those from the goose are more common. Swan quills are better, but more costly, and the crow quills are specially used for fine lines.

Not all the feathers of the goose are suitable for writing purposes; but only the five outer wings. Of these, the second and third are considered the best, and

those of the left wing are preferred to those of the right, because they curve outward and thus bend away from the writer.

The quill feathers are preferably plucked in the springtime from living birds. They are heated in a fine sand-bath of about 150° F. and scraped while still soft from the heat. This removes the natural greasiness and the outer skin, while it shrivels up the inner skin of the feather. After cooling, they are hard and elastic.

Since steel pens have become more common, goose quills have been also utilised as toothpicks, while other quills are made into holders for sable and camel-hair brushes.

Perhaps, however, the greatest use of feathers is for ornament. Feathers do not seem to have been used in Europe for ornamental purposes until the end of the thirteenth century. In the reigns of Edward III. and Richard II. they were worn in the conical caps of the time. In the time of Henry V. they had become part of the military costume. Towards the end of the fifteenth century the wearing of feathers in all classes of life had become carried to excess among the male population, and this habit may still be noticed among some of the peoples of Europe.

During the reign of Henry VIII. they seem to have first appeared in ladies' bonnets; by Elizabeth's time they had become an important part of female head-dress. As they grew in popularity among women, so men gradually used them less.

One kind of feather, however, has never attained popularity in modern times, although valued highly by Eastern potentates of the past—the peacock feather. In the peacock throne of Shah Jehan at Delhi, valued at £6,000,000 sterling, the tails of the two birds

standing by the throne are inlaid with most precious stones; but among most Muhammadans, as well as among the peasantry of England, France, Italy, Germany and Spain, ill luck is associated with peacock feathers, and, in the sixteenth century, garlands of peacock feathers were bestowed on liars and cheats. Muhammadan tradition places the peacock and the snake at the gate of Paradise, which place they are supposed to have betrayed to Satan; and peacock feathers were, in ancient times, used as funeral emblems in Europe, hence perhaps the superstition.

The feathers most in demand for ornament are those of the ostrich. The ostrich, a native of the African and Arabian deserts, is the largest of all living birds, and measures from six to eight feet in height. Not only is it most peculiar and interesting, but it is also very valuable from a commercial point of view. It is indeed the only bird reared exclusively for the sale of its feathers. With wings, useless for flight in the air, it is enabled to outstrip in running the fleetest horse; while to aid its gizzard in its functions it swallows stones, bits of iron and other hard substances, even the newly hatched birds consuming little stones before they take any food. The hens lay their eggs in a common nest—a mere hole scratched in the sand—and the males help the females to look after the eggs, and with the aid of the sun to bring them to life.

The flesh of the ostrich is not now eaten, although some hunters have declared it to be palatable, and it is recorded that Heliogabalus, the Roman Emperor, partook of a dish composed of the brains of six hundred ostriches.

The egg of the ostrich is the largest of any bird in actual dimensions, and is considered of great value. In the few countries from which ostrich feathers are

exported, great precautionary measures are taken regarding the preservation of this bird.

In French Western Africa the shooting and breeding of ostriches is not permitted without special authorisation. These birds may not be hunted, caught or exported, nor may their eggs be taken or sold. Ostriches being conveyed from one place to another must be provided with a passport indicating their place of origin and destination. Ostrich plumes may not be put on sale in that colony without a certificate of their origin. Within six months the proprietors of ostrich farms must take to the authorities a declaration of the birds they own.

Ostrich-farming is also practised in Argentina, Arizona, California, Kordofan and South Africa.

The breeding of ostriches and the development of the ostrich feather export trade has perhaps been carried on most successfully in South Africa, from whence the shipment of birds and eggs is absolutely prohibited in order that the higher quality feathers of commerce shall be obtained from there only. It is not certain who first started ostrich-farming in South Africa, but as early as 1855 Mr Kinnear, of Beaufort West, had a flock of these birds domesticated.

The two great factors in ostrich-rearing are (1) good irrigated land in protected valleys and (2) selection of the best birds for breeding. As much as £300 has been paid for a male and two females; and the number of birds run on irrigated lands is about five to the acre. As many as forty young ostriches in a year may be secured from one male and two females.

When the birds are eight months old they begin to yield feathers. These are clipped about every nine months, and the crops improve in quality with age. As the average return in feathers from each bird is

from £5 to £10, and sometimes £12, sterling per annum, it will be seen that ostrich-farming is one of the most profitable pursuits in the world. Some big farmers are said to have made £40,000 sterling in a year.

South Africa supplies the world's markets with about 85 per cent. of its total requirements.

Although London manufacturers buy little or nothing in the way of feathers above £20 per lb., the London Public Sales remain the premier, or perhaps the only, recognised market in Europe for ostrich feathers. At these sales the displayment and cataloguing of the feathers are in the hands of the Port of London Dock Authorities at the Cutler Street warehouse, and carried out to the entire satisfaction of the trade. There is, therefore, no preconcerted arrangement in the competition of the buyers, who attend from all parts of the world. Paris takes the best feathers, and New York comes next. Before the Great European War, Vienna had nearly equalled Paris, and was taking second place; and Berlin was fast developing an ostrich feather industry on a large scale, and buying large quantities of superior feathers.

The New York manufacturers, though they buy largely at the London sales, also buy in South Africa for direct shipment.

The feathers in most general demand, though the fashions fluctuate, are those of strong flue, good length, wide all the way, rich and square at the foot, and full at the tip, not pointed. The flue must be dense, not woolly nor drooping, but even all the way up. It must have lustre and colour, and be free from bar. The quill must be light, thin and hollow on the under side if possible. In drab feathers, the colour must be uniform. In black feathers lustre is desirable; feathers of bronzy appearance must be avoided.

In the subsequent preparation of the feather by the plumassier, white feathers are washed in hot, soapy water, then run through a pure warm water. Next, they are exposed to sulphur fumes, which bleach them; then they are blued with indigo solution, rinsed in pure cold water and hung up to dry. When dried, the shafts are pared or scraped for flexibility, and the barbs curled by drawing each, separately, over the face of a blunt knife or a heated iron. Those feathers which it is intended to dye a light colour are first bleached by exposure in the open air. Dull-coloured feathers are generally dyed black.

Next to the ostrich, the feathers most in commercial demand for ornament are those of the marabout and the bird of paradise, not forgetting the aigrettes of the heron. Swansdown is often used, like fur, for muffs and collarettes.

At one time, birds were destroyed indiscriminately for the sake of their feathers. In more modern times, many societies have come into existence to discountenance commerce in feathers which involves any cruelty to or wanton destruction of the birds; and some states prohibit the importation of certain plumes. Public opinion has certainly been influenced, as witness a letter from the New York Zoological Society recently read in the British House of Commons:

"You may say, on my authority, that seizures of forbidden plumage from the hats and trunks of passengers have caused no uproar or convulsion of any kind. The women who do not bring in forbidden plumage treat the law as a good joke on those who do. . . . Parisian milliners are now very careful not to sell to their customers any forbidden plumage, because when they do they are liable to lose their customers for ever."

There are good reasons, besides sentimental ones, for this limitation.

Bird life, by reason of its predominating insect diet, is the most indispensable balancing force in nature. At no period in its life is a tree exempt from insect depredations, and every part of it, from the genital seed, or nut, to the terminal bud, blossom or fruit, is attacked. The period of growth of leaf and blossom is also the nesting season of birds, and even seed-eating birds now feed their young on insects.

As the digestive organs of birds are so constructed and equipped that they can both contain and dispose of a very large quantity of food, and as most birds eat most of the time, the number of harmful insects consumed by parents and nestlings at the very time when such destruction is most needed is almost incredible. We can afford to spray an orchard tree which yields an annual dividend in fruit, but one cannot afford to spray a forest tree which yields its crop only in a lifetime.

For the preservation of his forests, man is wholly dependent on the services of the bird. In the woods of Canada, in the forests of Africa, in the jungles of India, in the bush of Australia, this faithful ally of ours, as a matter of course, and without any trouble or expense to us, is daily accomplishing, on our behalf, the superhuman task of saving the lives of the trees.

CHAPTER XXI

SHELLS

SOME years ago there was discovered, upon the eastern coast of Denmark and elsewhere, what appeared, at first sight, to be raised beaches. Scientific investigation pronounced them artificial constructions of "shell-heaps." Further investigation proved them to belong to an early part of the Neolithic Age, and among the heaps were found bones of the great auk, aurochs and other animals of a prehistoric age, while among the shells were those of giant cockles, mussels and periwinkles. At Amosi, in Japan, in Oregon, California, British Columbia and Brazil similar shell-heaps have been explored, to find traces of ruder races which were, in the course of ages, supplanted by the ancestors of the present populations.

Apart, however, from the interest which shells thus possess to the antiquarian, historian and geologist, they have played also a great part in the commerce of the past, and some shells have a great commercial value to-day.

Shell money is a medium of exchange among many primitive races, and appears, at one time, to have been universal, in the form of sea-shells or pieces of them worked into beads, or artificially shaped. In the islands north of New Guinea the cowrie shell and the common pearl shells are broken into flakes, through which holes are bored. The flakes are then valued by their length, measured from breast to breast. In parts of Portuguese West Africa the shell of the land snail cut into

circles, with an open centre, is used as coin. Until towards the end of the nineteenth century local trade in the Solomon Islands was carried on with a coinage of shell beads as a medium of exchange, the small shells being ground down to the required size, by women. This process being by no means easy, no more than were actually needed were made; consequently, the value of the coinage was maintained.

European pioneers of Northern America found that the Indians of Alaska and North California used a tusk-like shell, and those in South California the *tapis gracilis*, for coinage. As among the South Sea Islanders, the shells were valued by length, but were measured by the finger joints. Twenty-five shells strung together usually measured six feet, and were reckoned equivalent to £50 sterling.

The greatest commerce in shells for use as money has undoubtedly been in the cowrie shell, or, to give it its classic name, *Cypræa moneta*, a shell abounding in the Indian Ocean, particularly along the Ceylon and Malabar coast, Borneo and the Maldive Islands, and along the East African coast from Ras Hafun to Mozambique. Although another species, *Cypræa annulus*, is used in the eastern islands of the Pacific, the *Cypræa moneta* has been in universal demand not only in the countries adjoining the Indian Ocean, but throughout Africa for use as money. In the Sudan, parts of Northern and East Central Africa they were called *simbi*, and the Moslem traders from Zanzibar and Mozambique did a large trade in them with the peoples of these parts. Nigeria and Central Africa, on the western side, were supplied, however, from the west coast of Africa, the peoples of whom obtained them from European traders. Vast shipments of cowrie shells were made from the East to British ports, for reshipment to the west coast

of Africa, for before the abolition of the slave, and, indeed, until the middle of the nineteenth century, this cowrie shell was the usual tender; and as its value was much greater in West Africa than in its original home, the profits were very great, sometimes as much as 500 per cent. The people in the coast districts fastened the shells together in strings of forty or a hundred, so that fifty or twenty strings represented a dollar. In the interior, however, the *kurdi*, as this money was called, was counted piece by piece, or by fives, as it is done to-day in the remoter parts, where the cowrie currency still holds its own.

In parts of Nigeria and the Sudan, kings' revenues were formerly estimated at so many thousands or millions of shells; in one native state every full-grown man having to pay an annual tax of 1000 shells for himself, 2000 for every slave he possessed and 1000 for every beast of burden.

The cowrie shell was also, until the nineteenth century, extensively used for the same purpose in Bengal, the annual importations of this commodity to that part of India being valued at £30,000 sterling. As 3840 shells were required to represent a rupee (about 1s. 4d.), the vast number of shells annually dealt in commercially can be estimated.

Shells are also used extensively for ornament, both by primitive and civilised peoples.

Perhaps the most highly prized shell is the "mother-of-pearl." This is the internal layer of oyster and other pearly shells. Its silvery brilliance and iridescence are due to the alternate layers of carbonate of lime and membrane.

Before the discovery of Australia some of the best "mother-of-pearl" was obtained from Manila and Mergui, in Burma, for which as much as £320 to £400

per ton was paid. When Australia was discovered it was found that the natives inhabiting the northern coasts had been carrying on a primitive commerce in mother-of-pearl for a long time, bartering the shells and the pearls of the oysters with stray Malays from Macassar, receiving in exchange rice, tobacco, arrac and brightly coloured cloths. This primitive commerce constituted the only intercourse between Australia and any other country—if we except Tasmania—before it was discovered by Europeans. Besides exchanging these commodities, the natives used them for making fish-hooks and for personal adornment, suspending them by a girdle of human hair to serve the purpose of a loin-cloth.

The possibilities of this fishery attracted the attention of Europeans about the middle of the nineteenth century, with the result that it has developed into one of the most important minor industries of Queensland and West Australia. In the former state it employs over 3000 men. The fishing for pearl oysters is now largely carried on by highly organised fleets, each consisting of a large schooner of from 100 to 200 tons, on which the manager resides, and a number of boats or luggers (from 10 to 20 tons), each equipped with diving dress and pump.

The divers are mostly native Australians, South Sea Islanders, Chinese, Japanese and Malays; the Japs being perhaps the best. They receive £5 a month and commission. There are a few European divers, and these generally own their boats. The divers, of course, only form a small proportion of the whole number employed. The greater proportion is employed ashore repairing boats and gear, and in preparing, sorting in grades and packing the shell for export. In some cases divers themselves own or lease

vessels, which they provision for at least a month. These vessels are strongly built and average ten tons' burden. Each has a crew of six, including the diver, who acts as sailing master. When the diver descends into the sea one of the remaining men looks after the life-lines, and the other four work in pairs, in alternate shifts, at the pumping apparatus for supplying air to the diver. Larger cutters attend the boats with extra provisions in case of necessity through a longer stay in the fishing grounds; they also collect the shell from the boats. In such cases the diver receives a "lay" of so much per ton and has the pearls as perquisites.

New South Wales, having no pearl fishery of her own, participates in this commerce of shells by sending numerous boats to the Queensland fishing grounds, the centre of which is at Port Kennedy, on Thursday Island. The neighbourhood of the Torres Straits and Great Barrier Reef is rich in shell. Good finds have also been made in the north and south-east corners of the Gulf of Carpentaria.

A special Act of Parliament regulates this commerce in shells. The minimum size at which oysters may be fished is five inches. The annual licence for each small boat costs 10s., while for the larger vessels it is £3 sterling for a tonnage of ten tons or under, and 10s. extra for each successive ton or part of a ton. A lugger costs £80 to buy.

In the sorting of the shell for export to the United Kingdom and Hong-Kong distinction is made between the "white" shell, in which the silvery iridescence is uniform throughout, and the "golden-edged" shell, in which a well-marked golden edge appears. The former always commands the highest price and is found principally in Queensland, West Australia, Northern Territory

and Ara Islands. There is no difference of internal structure between these two kinds. The external surface of both when fresh is of a uniform light brown colour with silvery nacre. The average size of each is from six to nine inches, and each pair weighs from two to four pounds. The "Blacklyn" is another but smaller variety, which has radiant rows of white or yellow spots and a very dark green or bronze marginal band. Before the Great European War Germany was a large importer of these varieties of shell.

The "Shark's Bay" shell is mostly found along the northern coast of Western Australia, especially at the bay which gives this variety its name. Around this coast the "white" shell is also obtained, but it is the "Shark's Bay" shell which contributes most to the West Australian commerce in this commodity. This shell is greenish-yellow or pale grey, with traces of four or five brown or green radial bands. The lustre is not so bright as that of the "Blacklyn." At one time it was used for making pearl buttons, but since the utilisation of the American-Mississippi mussel for this industry the use of this variety of shell has decreased and, but for the pearls found with it, probably the search for it would be unprofitable.

The methods employed in obtaining this shell are quite different from those adopted to secure the "white" shell. The Shark's Bay oyster is found in dense clusters, attached by a "byssus" to one another or to other objects. Many can be gathered by hand from shallow banks left uncovered at low tide. Those in deeper water can be secured by ordinary oyster dredges. Between four and five hundred vessels are used in West Australia for exploiting this article of commerce, and the 8000 men employed are mostly Asiatics and Africans. The banks are worked in

blocks and held under exclusive licence for a number of years.

Then there is the Zanzibar variety, with copper-coloured margin, the "Bombay shell" from the Persian Gulf and the Egyptian shell from the Red Sea.

A less valuable source of mother-of-pearl is the Sici or Trocas shell of the Fiji Islands. This variety is found on the top of the sea reef. Sici shells are worth from £12 to £48 per ton, and are exported chiefly to France and Japan for button-making.

Substitutes for mother-of-pearl are to be had in the green snail shell and the green ear and ormer shell.

At the outbreak of war, the Australian pearl industry was depressed, but it has since recovered, and over 2000 tons are now yearly shipped, valued at over £200,000, the shell fetching from £100 to £200 a ton.

CHAPTER XXII

PAPER

OUT in the sunshine in country or suburban lanes you may see some tramps picking over a bundle of rags. What will they do with them ? Sell them to be made into paper.

Out in the forests of the Far West trees are being felled. Why ? To be made into pulp for paper.

Paper was so cheap just before the war that people threw it away in much the same way as they wasted matches and still waste water.

For a halfpenny one could obtain eight large pages or more of paper containing all the news from everywhere in the world. The actual paper itself, however, cost but an infinitesimal portion of the whole product, the machinery, the type-setting, the obtaining of the news and the management absorbing almost all the expense of the newspaper published by the world's Press. Yet the actual paper itself constituted, and still constitutes, a vital portion of commerce, over 11,000,000 tons of timber being consumed for pulp paper for the newspapers of the world, while the Press demand for this valuable commodity forms but a fraction of the commerce in the article.

The romance of paper, however, begins centuries before rags or timber were used to produce it. The name itself is derived from the papyrus, an Egyptian reed, the stalk of which furnished the principal material for writing upon to the nations bordering on the Mediterranean in primeval times.

The Egyptians found that by placing thin layers of papyrus in such a position that they overlapped at the edges, and then placing layers crossways upon these, they made a thick sheet which they pressed and dried in the sun. Now the fibres are separated and dried by artificial heat.

The bamboo was used for paper-making before the time of Christ, and is still the material from which is made the greater portion of the coarse, light brown paper commonly used in Chinese life. In fact there are not wanting modern experts, always on the look-out for various paper-making materials, who claim for bamboo pulp many advantages. It can be had in parts of the world where other pulp materials are not to be had; it can be made with a regular land crop, controlled by the pulp factories, which can be produced in any amount in three years; it is usually accessible to water or other cheap transportation; it produces a fine pulp which felts readily and produces a thick, opaque paper of greater thickness than usual for its weight, making it especially suitable for particular varieties of paper; the fine, flexible fibre is easily digested by the ordinary bisulphide process, and the bamboo can be readily handled mechanically and chemically; and as a crop material its price and the abundance of its supply can be controlled within narrow limits for the benefit of the factory to be supplied.

Paper is also made in the East from the young shoots of the paper mulberry-tree, specially cultivated in Japan and China. The bark is detached from the wood and steeped in water. Then the outer and inner barks are separated, the former making better paper than the latter. After the bark has been boiled and washed it is beaten into a pulp and placed in water, with an infusion of rice and manihot root (tapioca). This

solidifies the pulp, and it is pulled off in sheets of paper, the juice being used as glue.

The next material, in chronological order, from which paper was made was from cotton rags, usually mixed up with the more primitive material for pulp-making. The Chinese appear to have made paper like this about the time of Christ. When the Arabs captured Samarkand, A.D. 704, they found cotton paper there. Afterwards they introduced it to Europe through Greece. The Moors used it in Spain and introduced it into Italy. The Empress Irene of the Byzantine Empire is said to have issued rules to nuns of Constantinople on cotton paper in the eleventh century, and the oldest MS. written on cotton paper in England is in the Bodleian Collection in the British Museum, dated 1049. One of the oldest and most interesting cotton documents extant is the deed of King Roger of Sicily, dated 1102. The fragments of the Gospel of St Mark at Venice, one of the oldest pieces of writing preserved, is written on skin.

Rag paper is spoken of by the Abbot of Cluny in the early part of the twelfth century, and linen paper was made in the fourteenth century. Until nearly the end of the eighteenth century all paper was manufactured by hand in moulds of various sizes, but the wonderful inventions of machinery have since ended the industry of hand-made paper, except for special purposes. Rags also are used only for the best quality of papers, while wood is in demand for the cheapest.

The black spruce of Newfoundland is declared by the experts to be the finest in the world for paper-making, a log of this tree containing 15 to 20 per cent. more fibre than a white spruce log of the same bulk, owing to the smaller size of the wood cells of the black spruce. Hence it was that the Harmsworths and other great newspaper capitalists, seeking a place where they could

make their own paper from nature's material on the spot, fixed upon the centre of Newfoundland, in the upper section of the Exploits valley. Here black and white spruce are in abundance, and forest growth can reproduce itself perpetually, each tract cut or burned being estimated, in fact, to yield again within thirty years the wood fit for pulp. Some of the trees are from twelve to thirty-six inches at the butt; and while in the United States the owner of pulp wood areas has to pay taxes, dues and other charges on mills, logs, lands and lumber, in Newfoundland he pays no such imposts.

One of the most fascinating romances in connection with paper and pulp is that of the astonishing development of Newfoundland since the Harmsworths, Reeds and other big capitalists interested in paper started their mills in the midst of the forests and created a new industry for the people.

A few years ago the neighbourhood of the Grand Falls was a wilderness, with scarcely an inhabitant. To-day there is a large town, ranking second in the island in population and commercial interest. Concrete mill buildings, miles of railway, dams and piers have been built, all representing many thousands of tons in material and thousands of pounds in money for labour. A thousand men are employed there daily, and a sum of £150,000 is annually paid in wages.

The wood for the purposes of manufacture is obtained from the land around Red Indian Lake, the water of which is used for log storage and log floatage. The company's steamers tow logs to the booms at the foot of the lake, from whence they are conveyed to Grand Falls by the Exploits river, over 50,000,000 feet of timber being transferred in this way.

The mills which treat the paper are the most modern in the world, the ground wood mill turning out over

By permission of] ["*The Daily Chronicle*"

FUTURE NEWSPAPERS: STOCK OF WOOD-PULP AT SITTINGBOURNE

The wood-pulp from Norway and Canada is waiting for conversion into paper at the paper mills of Messrs. Edward Lloyd, by whose courtesy this illustration is reproduced.

500 tons a day and the paper mill about 200 tons of finished paper daily. This commerce in paper has almost equalled in value the celebrated fisheries of the island. To quote an expert:

"Every ton of paper represents at least $12 directly or indirectly to the wage-earners engaged from the time the tree is cut down in the forest to the time the finished product is put on board ship. Every ton of paper represents, roughly, a cord and a half of wood. An acre of good forest land will produce about nine cords."

Canada had, in 1919, no less than ninety paper mills.

The enormous demand for paper to provide the modern newspaper is everywhere making an inroad upon the world's forests for pulp. This is causing experts to seek for an additional paper-making material.

At the present time the by-products of several crops are wasted, although they would serve quite well for the manufacture of paper. Hitherto these materials have not been employed to any large extent, owing to their inability to compete with wood, but owing to the diminishing supply of the latter (especially spruce and poplar), and the increasing consumption of pulp and paper, it is probable that before long it will be possible to utilise profitably maize stalks, broom corn, rice straw, bagasse, flax straw, cotton stalks and cotton hull fibre (*i.e.* the fibre which adheres to the hulls or seed-husks after the cotton has been removed by ginning). Hemp could be profitably grown exclusively for paper-making purposes. The pages of a circular issued by the U.S.A. Agricultural Department are composed of different kinds of paper made wholly or in part from crop wastes and by-products from maize, broom, corn, rice and cotton.

When we consider the great change which has taken place during the last hundred years in the material

used, the methods employed, the machine improvements, and the exceptional demand for the commodity, we shall scarcely be surprised at any new invention or substitute which may come into existence during the next few years and play its part in the commerce of paper.

Two special developments in the use of paper apart from the demand of the newspaper world deserve a brief notice.

Quite a romance is attached to the origin of blotting-paper.

Early in the nineteenth century ordinary paper was being made from rags in a mill in Berkshire. A thoughtless workman forgot to put in the sizing and the whole of the paper was believed to be spoiled. Just then the angry proprietor sat down to write a letter, and as it was not a very important one it occurred to him to utilise a piece of the condemned paper. To his surprise the ink spread all over the paper. Then the thought flashed upon him that here was a substitute for drying ink, for which sand was then used. He disposed of his stock of damaged paper and his success led to the general use of blotting-paper.

The United States Senate and the British Parliament are said to be the only public bodies in the world which still use sand instead of blotting-paper.

The manufacture of papier mâché and hard paper-ware is also full of interest. In the former, different kinds of paper are pulped into a homogeneous mass of doughy consistence. Earthy material is mixed with it, also glue to harden it and prevent attacks by insects. When rolled into thick sheets, a sufficient quantity is taken to form whatever article it is desired to make, and this is heavily pressed between cameo and intaglio dies, and then dried. The surface is afterwards gilded,

varnished or painted with oils, and the article is then tough and light. Table and desk furniture and many ornaments are made from this material.

Hard paper-ware has become yet more important commercially, for barrels and boxes previously made from wood, telephone and telegraphic apparatus, insulating pipes, printing and harvesting machines and other apparatus formerly made of glass, metal and vulcanised rubber, are now being made from ordinary brown paper specially treated by tension on the mandrel in winding, strengthened by pressure rollers. After numerous experiments extending over several years a British company has demonstrated the superiority of this paper-ware under severe conditions of steam, moisture, vibration, heat and dryness, added to which, of course, is the advantage in weight and cheapness.

CHAPTER XXIII

PRECIOUS STONES

FROM time immemorial man has loved to bedeck himself with ornaments of all kinds, and everything in nature which appealed to him as beautiful or mysterious, or a combination of both, has been eagerly sought both for the gratification which such possession gives, and for its commercial value in exchange for other commodities.

The term "precious stones" is usually used to include all those gems which are valued for ornament and jewellery. Strictly speaking, however, the only precious stones are the diamond, ruby, sapphire and emerald, although the term is often extended to the opal, notwithstanding its lack of hardness, and to pearl, which is an animal product.

In this chapter, therefore, we have taken advantage of the extension and included also one or two gems which are either noted for some peculiar quality, or for which there is a peculiar demand on the part of certain people.

Of all precious stones the diamond, although not the most valuable, is the most celebrated and the most useful. A transparent, translucent mineral of pure carbon, the diamond derives its peculiar brilliancy from the fact that the back planes reflect all the light which strikes them at an angle exceeding 24° 13′.

The diamond is the hardest substance known and is able to scratch all other minerals. This quality has greatly extended its sphere as a commercial commodity.

The engraver uses it for etching-points, and the glazier uses it to cut glass. Of course for these purposes only a tiny splinter is used. The geologist and engineer also use it at the tip of their drill for boring rocks. This hardness in the diamond gave rise among the ancients to many superstitions concerning it. Even Pliny tells us that "when struck on the anvil it returns the blow in such force that hammer and anvil are shattered. . . . It is incapable of being burnt." The anvil test has spoiled many a diamond, and the Florentine Academicians in 1692 burnt the stone in the focus of a large lens.

For many years the only source of supply of diamonds was the East, and there the stone was not valued for its usefulness, but for its magnificence as a gem and ornament. Each of the great historic diamonds of the East has its own romance.

The "Great Mogul" and the "Koh-i-nur" were the most treasured gems of the great Mogul conquerors of India. The first was lost during the sack of Delhi by Nadir Shah of Persia, and has never been found.

The second was hidden by the Emperor Muhammad in his turban when Delhi was taken. A woman was the only observer of the Emperor's act, and she betrayed the secret to Nadir. That conqueror in the reconciliation between the two monarchs a few days afterwards suddenly asked the Emperor in front of the Durbar to exchange turbans as a token of the friendship and reconciliation which had just been sworn, and Muhammad could not refuse or even extricate the diamond before the whole court. Nadir's son, however, was afterwards overthrown by Aga Muhammad, and tortured in vain to reveal the hiding-place of this diamond. The maimed monarch gave the gem to the Afghan Prince Ahmed for his help, and one of his

successors passed it to Runjit Singh of the Punjab. Here it was captured in 1840 by the English, and sent to Queen Victoria. It is now among the royal jewels at Windsor.

Two remarkable instances of the profitable commerce in diamonds are those in connection with the "Orloff" and "Regent" diamonds. The first was stolen from a Brahma temple by a French soldier, who sold it for £2000 to an English captain. He sold it to a Jew for £12,000, the Jew sold it to Prince Orloff of Russia for £90,000, and Orloff gave it to the Empress Catherine II., who rewarded the donor with a pension of £4000 a year.

The "Regent" stone was stolen from a diamond mine by a slave, who made a hole in his leg to conceal the gem. Escaping to the coast, he gave it to a merchantman captain for a passage to England. The captain sold it to Thomas Pitt for £20,000, and Pitt sold it to the French Regent for £135,000. But for this money, perhaps, the British House of Commons might never have seen or known the two illustrious descendants of Thomas Pitt. Napoleon afterwards placed this diamond in the hilt of his sword and pawned it to the Dutch Government for a loan.

Diamonds have been discovered since in many parts of the world, and particularly in Brazil, South Africa and West Africa; and in almost all cases by accident. Each discovery has been a romance, but these stories and those of the wonderful methods and results of diamond-mining in South Africa belong to the romance of mining. In each of these discoveries, however, the earth has shown signs of previous volcanic activity. But while the author was in West Africa diamond-bearing blue clay was found in a region which bears no such trace. A woman who was digging out blue clay

for pottery-making at Ikotobo picked out a little "star," as she called it, and placed it in the mud figure of a household god, as the Hindus placed their diamonds in the eyes of their temple images.

The best diamonds are usually colourless, but a blue-white shade is very rare, and one such, known as the "Hope" diamond, though only four and a half carats in weight, fetched £25,000. The value of stones from one to twenty carats is roughly calculated by multiplying the square of the weight in carats by the price per carat; above twenty it is far more.

The Oriental ruby, sapphire, emerald, chrysolite, topaz and amethyst are all varieties of corundum, a mineral which is only inferior to the diamond for hardness, and is found in crystalline limestone (*e.g.* in Burma), and in alluvial sands and gravels derived from igneous and metamorphic rocks.

When coloured, as in the case of all the varieties mentioned above, it shows a striking dichroism, being deeply coloured when viewed along the direction of the vertical axis and pale coloured when viewed at right angles to this direction. Hence the red variety, the Oriental ruby, can be distinguished by this experiment from the garnet, the Balas ruby (found in Bokhara) and the Spinel, which are cheaper, more common and more brittle, and are not corundum gems.

Of the different varieties of corundum mentioned above the ruby is red, the sapphire blue, the emerald green, the chrysolite yellowish-green, the topaz yellow and the amethyst violet. The finest collection of topaz is said to be that in the National History Museum at South Kensington.

The best known and most popular of the corundum gems are ruby and sapphire; and they are usually found close together. The ruby is the rarer of the two

and therefore more valuable. The price per carat of the sapphire is independent of the size of the gem, but the larger rubies fetch a much higher price per carat than the small ones. Rubies and diamonds are always associated together as the most precious of stones. Thus Dryden sings :

> " His ample forehead bore a coronet
> With sparkling diamonds and with rubies set."
>
> *Palamon and Arcite*, iii. 54.

The Gaekwar of Baroda has a coat woven of gold and embroidered with diamonds and rubies which cost £25,000 sterling ; the Emir of Scindia possesses a brilliant scarlet coat and a cap of black and gold studded with rubies and diamonds costing over £30,000 ; and many other Eastern potentates possess similar collections.

A large ruby is more valuable than a large diamond, weight for weight. Some experts affirm that a five-carat ruby is worth ten times as much as a five-carat diamond. Certainly an eleven-carat ruby has been known to fetch £7000 sterling, while an eleven-carat diamond is estimated at only £1000 sterling in value. These were pre-war prices.

Rubies are found in Ceylon, Borneo, Kashmir, Siam, Afghanistan, Montana in the United States, and New South Wales, but only a few come from any of these places. The bulk of the rubies in commerce come from Mogok, ninety miles north-east of Mandalay, the capital of Burma. For three hundred years the Burmese kings, who loved the " pigeon-blood " stones, as they called them, owned the area of land upon which the rubies were found. The possession by any private individual of a ruby worth more than £70 was a crime, and the ruby-fields were forbidden ground to the stranger. Since Great Britain annexed Burma in 1885

these ruby-fields have been worked by an English company, on lease till 1932. The most valuable stone found here weighed 77 carats.

The sapphire, the blue variety of corundum, is mentioned in the Bible as being the second stone in the second row of the high priest's breastplate, and again in the Book of Job as a precious stone; but there is some doubt whether the modern sapphire is, in either place, referred to. Sapphire is usually found with the ruby and other forms of the corundum, but in Siam sapphire is more common than in Burma.

The method of winning both gems from the surface gravel is similar and simple. The gravel is excavated and carried off in baskets by men working in small parties of three or four. In Burma, however, hydraulic machinery and other scientific improvements have been introduced, but this forms part of the romance of mining. After washing the gravel, the gems are picked out by hand, usually by Europeans, and sorted into about a dozen different qualities. The best come to the London market, the others are sold by auction fortnightly to local dealers.

A large amount of corundum gems of inferior quality is used for making jewelled bearings of watches and for various electrical instruments; a small amount is also used for wire-drawing. For such purposes colour and transparency are of little account, but the minerals must be pure, free from parting planes and must break with a conchoidal fracture. Over 20,000,000 of watch jewels are sold annually.

Besides the Oriental emerald, which, as previously mentioned, is a form of corundum, there is the ordinary emerald found in Peru, Columbia, Bolivia and Siberia. This is a variety of beryl, from which, however, it is distinguished by its colour of emerald green instead of

pale green, light blue, yellow or white, the colours of the beryl. This shade of green is produced by the presence of chromium, those of the beryl arising principally from the presence of iron. The precious emerald is valued, in commerce, next to the ruby and diamond, sometimes before the latter.

The search for emeralds requires great patience and industry, for disappointment is more frequent than success. Often there is little or nothing to guide the prospector, the whole formation of black carbonaceous limestone being covered with earth to a depth of from six to thirty feet, as at Muzo and Cosquez in Columbia, where some beautiful gems are found embedded in veins of calcite, the veins sometimes being less than six inches in depth. The earth deposit, frequently covered with jungle, has to be removed before prospecting is possible, and a break may prove quite valueless after months of work have been expended upon it.

Emeralds which are exposed in the course of quarrying are carefully loosened and detached from the matrix by a "pricker," the other quarried material being broken up by light hammers in sorting sheds. The fragments of these remains are closely examined for gems. Some of the stones found thus can be picked out clean. Others have to be cleansed from the adhering matrix, by treatment with cold dilute hydrochloric acid.

Before being marketed, the emeralds are sorted into about fifteen different grades.

Emeralds have been found in different parts of the Andes since the sixteenth century, and the deposits around the district of Muzo, Columbia, previously mentioned, are believed to be inexhaustible, in spite of many disappointments.

The opal is a non-crystalline mineral of hydrated

silica occasionally displaying a beautiful play of colour, hence its value as a gem stone. The precious or "noble" opal, as the real gem is called, is, however, but one variety, and is only found in a few places. The finest opals come from Hungary, near the village of Vorosvagas or Czerwenitza. For centuries, in this place commerce in opals has been carried on, one uncut specimen preserved in the Imperial Museum in Vienna weighing about 3000 carats. Other places where the "precious" opal is found, are the Mexican state of Queretaro—where it occurs in a porphyritic rock at Esperanza; at Gracias á Dios in Honduras, in Queensland near the Barcoo river, and in New South Wales, Yungnulgra county.

The opal was valued by the Romans next to the emerald, and a rich Roman senator, Nonius, was exiled by Mark Antony so that the latter might seize the former's magnificent opal, which was as large as a hazel nut. Because of its marvellous colouring, the opal has always been surrounded by superstition. By some people it is regarded as a lucky stone, by others as unlucky.

Another stone regarded with great superstition, but of good omen, deserves some notice. Jade is found in Asia and Oceania, and is celebrated for its toughness, and for its popularity, particularly among the Chinese.

Many centuries ago, in ancient China, it was believed that a cup made of jade, gave health to him who drank from it, and also counteracted poison. Emperors, nobles, and fathers of families who feared poison gave high prices for jade drinking vessels, for it was believed that liquid containing poison would foam up when brought into contact with this mineral. Even to-day it is still the "lucky" stone of China, and a sceptre or a cup of jade is a gift made to a man whom the Emperor

desires to honour. The most valuable jade in a Chinaman's eyes is a particular shade of dark green, semi-transparent, brilliant and hard.

But commerce in jade was and is not confined to China. In ancient European tombs of the Stone Age axes and hatchets of jade have been found. Columbus discovered that a jade-like stone was held in high honour by the natives of Central America. Amulets of Amazon stone, akin to jade, have also been found in Egypt. Spaniards of a few centuries ago firmly believed that this stone hung about the body was good for the kidneys and stomach.

Jadeite is not the pure jade, but possesses the colour which the Chinese fancy. As these people are the greatest purchasers of jade in the world there is a good commerce in the article. Jadeite is found in masses of interwoven crystals embedded in the laterite and serpentine rocks. The purest forms are white in colour, but the most valued are those green stones with a red staining. The latter are found in the laterite rock, and are much prized by the Chinese.

The list of mineral stones extracted from the earth to be cut or polished into gems for the adornment of men and women, idols, temples and thrones is almost inexhaustible.

But all the stones or gems valued thus are not extracted from the earth. A few are found in strange places and have a more mysterious origin.

Two of these deserve special attention, the pearl and amber.

Pearls are morbid growths or cysts found in many shells, particularly in those of the oyster and mussel, but the best come from the pearl-oyster or Oriental pearl-mussel around the shores of the Persian Gulf, Ceylon, Burma and Venezuela. During recent years

private enterprise has been centred upon the South Pacific as a pearling ground, and several 150-ton schooners and numerous thirteen-decked boats are employed.

From the time of Pliny the pearl-fishing grounds of the Persian Gulf and around Ceylon have been celebrated, and many were the speculations as to the cause of the existence of pearls in the shell-fish. Until recently they were thought to be due to irritation caused by boring sponges or tapeworms, but special examinations by experts of over 30,000 pairs of separated valves prove that these animals have little influence in pearl production. Quite 90 per cent. are due to the attachment of cysts to the nacreous lining of the shell, which Dr Lyster Jamieson maintains is caused by the immigration of the epidermis into the tissues. Pearls have skins, like onions, and a bad lustre can be improved by "skinning" and the value thus enhanced by about £100.

At one time pearls of considerable value were found in the mountain streams of Britain and Canada, and the Scottish and Irish pearl fisheries were flourishing industries.

Pearls have three layers, like the shells, but the innermost layer of the shell becomes the outermost in the pearl.

In Ceylon the oyster is found in shallow and well-sheltered waters. In the Mergui district of Burma it lives at greater depths, is exposed to rapid currents and is reproduced less rapidly. The Mergui pearls are, however, above the average in size and appearance, and ordinary single pearls from this district realised from £300 to £1600 before the war. In 1919 a few special stones were sold at £5000 to £6000 each. Mergui mother-of-pearl is also of the best quality, and more than eighty tons of this commodity are annually exported.

Off the coasts of Venezuela the Spaniards, from the time they conquered the mainland, carried on pearl-fishing; but towards the beginning of the eighteenth century this commerce was abandoned, and was only revived again in 1895. There, the oysters are collected by divers or by an implement called "arrastra," a small drag provided with a net into which the oysters fall as they are detached by the drag. Small sailing boats manned by four or five sailors draw this drag over the oyster beds, and if each boat has two arrastras, it can collect four or five bags daily. A diver can obtain three times the quantity; but the diver's dress, being costly, is restrictive to this method of obtaining the pearls, besides which his licence costs three times as much as that for a boat.

About 5000 men are employed in the Venezuelan pearl fishery; and most of the pearls are purchased by Syrians on the spot. The price for unsorted pearls is about half-a-crown per carat, but some single pearls have reailsed £150. The Venezuelan pearls are white, and all of them find their way to Paris or London.

Smaller and inferior pearls are found in a land-locked bay on the north-east coast of Ceylon, known as Lake Tampalakamam. Here, upon a dark grey-black mud intermixed with quartose sand, is found the Placuna oyster, with valves which, during the first year of its existence, are so transparent that one can see its whole anatomy, even to the beating of its heart. At two years of age the shells become more massive, and gradually turn white and translucent. At three years of age its size is about seven inches by six. The shell is used as a substitute for window glass. Placuna pearls are used in India for placing in the mouths of the dead at certain funeral rites, while in China they are reduced to powder and used as medicine.

In Ceylon the pearls are mostly secured by divers, who receive half the catch as their remuneration, but are obliged to open their oysters fresh and sell what pearls they contain, at whatever price the renter of the fishing rights chooses to pay. The diver makes from two to three hundred descents during the season, from about January to May, and he may secure daily from two to three thousand oysters.

Amber is a precious gem which, by reason of its peculiar properties, has helped to play an important part in commerce. Thales, the Greek philosopher, discovered that amber, when rubbed, becomes warm, and attracts light bodies to itself, as the loadstone attracts iron. Thus was founded the science of electricity, ἤλεκτρον (electron) being the Greek word for amber.

The Romans called it *succinum*, or gum-stone, possibly because of its gum-like appearance, but possibly also from a partial guess at its real origin. For amber, besides its mysterious properties which made the ancients regard it with superstitious reverence, has also a weird origin, which was at one time enveloped in mystery. It is now known to be a fossilised vegetable gum which once exuded from an extinct cone-bearing tree of the prehistoric forest. That it was originally liquid, is indicated by the ants, flies and other insects found embedded in it, while even in its solid state, it may be set on fire, when it burns with the scent of resin.

Numbers of ancient peoples believed amber to be a cure for insanity and fever when worn round the neck as an amulet.

During the reign of Nero the Romans made an exploration of the amber country, and we are told that 18,000 lbs. of amber were brought to Rome, including a piece weighing 13 lbs. Later, amber was made into

knives and forks with one prong, used only by great princes and prelates. At that time it was more valuable than gold.

The beautiful amber cup found at Hove, with stone and bronze utensils, in 1870, and now in the Brighton Museum, is said to be the finest specimen of amber in Europe.

On the Baltic coast, particularly on the shores of Eastern Prussia, where the Great European War of 1914-1918 waged fiercely, masses of amber are frequently thrown up by the sea, and women and children pick off the amber entangled in seaweed specially caught in nets. Between Königsberg and Memel rounded masses of amber are found under the stratum in pyrites, sulphate of iron, and sand, at a depth of from forty to one hundred feet.

A kind of amber, but different from any other form of fossil resin, is found in Burma in clays of the Meiocene Age and in the oil-fields. It is harder than the Prussian amber, is easily cut and takes an excellent polish, but many thin films of calcspar are included, and there is less variety of colour than in Baltic amber. When light is thrown upon it at a certain angle a bluish tinge is given to this Burmese amber. Rosaries, trinkets and figures of Buddha are made from this commodity.

The stories attached to these and other stones, more or less precious, would fill volumes. Valued from the remotest ages, commerce in these articles shows no diminution, but rather an enormous increase, as civilisation progresses. Every ornament or decoration of value, worn by monarchs and statesmen, or given by them as rewards to faithful followers, is still set with jewels.

"You call these toys," said Napoleon. "Well! you manage men with toys."

CHAPTER XXIV

METALS

A SHORT time ago the Society of Antiquaries announced some interesting discoveries made during excavations at Hengistbury Head, Hampshire. Among the curiosities was a collection of many thousand gold, silver and bronze coins which had once been used by the ancient Britons and the Gauls. Most of them were copied from Greek originals, principally a coin of Philip of Macedon about the middle of the fourth century B.C., with a head on the reverse and a chariot on the obverse. Some were covered only with dots and lines. Bronze and even gold cups were found in places where the people had apparently lived in huts of mud and wattle, and traces of the refining of iron and other metal-work were also discovered.

Long, however, before the time of the ancient Britons the precious metals were being sought and worked by the nations of antiquity, and particularly in the East. From the beginnings of civilised life gold and silver have been always in request, both for ornament and as a means of exchange, while the other metals were utilised especially for weapons and useful articles.

Gold was probably the first metal to be discovered, as it exists in its pure state in so many countries, lies on the surface, attracts the eye and can be easily secured. It is chiefly found in veins of quartz or as "placer" gold in the gravels and sands of streams as the result of the weathering of auriferous rocks. "Grains" or "flakes" are disseminated through the

quartz or gravel; when found in larger pieces, they are "nuggets." Much of the gold of commerce is obtained as a by-product, in the mining of silver, copper and other metals; and gold and silver are frequently found and mined together. Gold has always, however, maintained an ascendancy over silver among precious metals; one of the principal reasons, perhaps, being that it does not tarnish like silver. On the other hand, it is comparatively soft, and has to be alloyed with other metals—principally silver and copper—to make it durable.

As a rule, wherever gold has been found conquest and exploration has taken place, leading to subsequent development of lands and countries which otherwise might never have become highly civilised or, at any rate, would have been much further back in the march of progress.

As far back as the time of the Phœnicians, those redoubtable pioneers of commerce and exploration, Ophir and Tarshish (probably in Spain), and the coasts of West Africa appear to have been exploited for their gold. In the days of King Solomon we are told that "silver was nothing accounted of" by Eastern princes and monarchs, whose palaces and thrones were decked with gold, either brought from India, where the aborigines slaved for their princely conquerors from the north, or from Africa and the west by the Phœnicians.

The "dumb commerce," by which the Phœnicians are said to have carried on their commerce with African natives, is thus described by Herodotus:

"Outside the pillars of Hercules (*i.e.* the two promontories which shut in the Straits of Gibraltar) there are people living in Libya. The Carthaginians come to their country and unload their wares and, after

arranging them on the beach, return on board their ships, and light a fire. The natives, seeing the smoke of the fire, come to the sea coast and put down gold in exchange for the wares, and withdraw to a distance. The Carthaginians then disembark and look at the quantity of gold, and if they think it is enough, they take it up and go away; if it is not enough, they go back to their ships and wait there. Then the natives approach and add more gold till they satisfy the Carthaginians. Neither side treats the other unfairly; the Carthaginians do not touch the gold till it has been made equal to the value of the goods, and the natives do not touch the wares till the Carthaginians have taken the gold away" (Her. iv. 196).

Slightly different were the methods of the Portuguese with the Indians of Brazil, whom they found adorned with gorgeous ornaments of gold. The former demanded of the latter that they should be shown the gold locality. When the natives refused, one of the Portuguese poured some spirit, which the natives thought was water, from a flask, and set fire to it, saying that he and his comrades would set fire to all the rivers in their country if they did not show them where the gold was to be found.

Still rougher were the Spaniards with the natives of Peru and Mexico.

Both in ancient and medieval societies, however, the mining for gold was not considered honourable toil, but only to be performed by slaves; and where the Phœnicians mined their gold, whether in Spain or in Rhodesia, to which they penetrated, crushing stones and mortar holes have been found at which African slaves wore out their miserable lives. Recent research has demonstrated that to the Phœnicians we owe

the numerous galleries and pits found throughout Rhodesia, particularly in that neighbourhood of which Mr Rider Haggard has drawn his sketch *King Solomon's Mines*. When they abandoned these mines they walled them up.

Whether from these sources or from India came the three great statues of beaten gold so famous in Babylon we do not know, but we are told that Darius was able to wring tribute of over £2,500,000 out of his satrapies.

The Romans made of Spain a Siberia, Pliny and Titus Livius telling us that 20,000 lbs. weight of gold came annually from that country. The Romans also are said to have found and worked gold in Caermarthenshire.

As for the treasures of the New World, although the natives apparently never took the trouble to sink shafts or detach gold from the dross surrounding it, yet Cortes in Mexico found gold and silver plate to the value of £1,500,000, and Pizarro in Peru melted down more than double that amount.

In more modern times, whenever gold has been found there has been a huge rush of the free population of almost all countries to the spot, and fearful are some of the stories told of lives lost and ruined in the search for gold. Amid such a general scramble it is refreshing to find one exception noted. An eminent authority has pointed out that—

"With a score of potential gold-fields at their very doors Brazilians exhibit the unprecedented spectacle of a nation of some 20,000,000 souls apparently immune from that 'gold fever' which, in comparatively recent times, was the direct cause of the opening up and present-day stupendous progress of California, the Transvaal,

Victoria, New South Wales, Western Australia and a host of other places which, but for these gold rushes, might long have remained neglected by agriculturist and manufacturer.

"The only time that anything like enthusiasm took place was in the early part of the eighteenth century at various points in Minas Geraes, and even then the discovery of gold was not seldom coincident with undertakings intended specially to promote the development of the iron resources already brought into notice at the beginning of the seventeenth century. The finding of gold was thus, even then, by no means invariably the result of a search for that metal alone."

Gold was early adopted by nations as a currency, but it was not adopted in England until 1257, the first gold coins being of the weight of two silver pennies, valued at twenty pence and called gold pennies. In 1344 a gold piece called a florin was struck. Later came "nobles," worth 6s. 8d., still used as a lawyer's fee; "marks," worth double that amount, and "angels," worth 10s. each.

The guinea was first issued in the year of the Great Fire of London. At first it was valued at a price varying from 20s. to 30s., but in 1777 it was fixed at 21s. The gold "sovereign" was substituted for it in 1816.

To the Royal Mint in England anyone may take ingots or bars of gold and for a small charge get their value in coins. The ingots and bars are marked and weighed for the melting-pot, the exact amount of alloy being set beside them. Then they are melted in small crucibles of plumbago. When molten, the metal is lifted from the furnace by a special apparatus and its contents poured into moulds. These cast the metal

mass into bars of about twenty inches long. The bars pass through presses, which reduce the bars to varying degrees of thickness according to the size of the coin required. The long strips of thin metal are then taken to another machine, which punches them to circular shape, while another machine "mills" the edges, to prevent the coins from being "clipped" when in circulation. In days gone by "clipping" the coin was of frequent occurrence, and several monarchs resorted to debasing the coinage when they were pressed for money. Later, counterfeiting coin became a crime of high treason, and death was the penalty. To-day it is still, and rightly, a major offence.

After leaving the press, the gold coins are placed in a machine which automatically deposits them in one of three drawers, according to whether they are light, heavy or correct. Those of the first and second description are sent to the melting-pot before those which are good are given public circulation. They are again weighed and tested. To ensure perfect weight and fineness, samples are placed in a "Pyx" box. Each year a jury of qualified men is sworn in to examine these samples.

Although silver takes a secondary place to gold among precious metals in commerce, its use in coinage has caused more fluctuations in prices, and its discovery and use are the subject of quite as many romances as those of gold.

A short time ago, when the new "Treasury" in Rochester Cathedral was opened, a great old sixteenth-century chest was opened and the contents displayed for the first time. Among other curiosities a number of magnificent pieces of silver were found which had previously been supposed to be brass. In mentioning the discovery, *The Times* said:

"The silver alone is a revelation. Chief among the pieces, are two beautiful dishes, *ciboria*, of the date of 1530-1533. They are five inches high and nine inches wide, and have, between them, one cover. It is conjectured that there was originally but one, which is transferable to either of the vessels.

"Next to these must be mentioned a magnificent service of seven pieces, of date 1653-1654, originally made for James, Duke of Lennox and Gordon, who lived at Cobham Hall, and bequeathed to the Cathedral by will by Sir James Williamson in 1701. The pieces consist of two chalices, two *ciboria*, two flagons—all very fine—and a superb alms dish, two feet in diameter, the seven pieces weighing over 440 ozs. Part of the same Williamson bequest of 1701 are two splendid candlesticks, nineteen inches high, richly chased and massive. These candlesticks and the alms dish, which have been in constant use in the Cathedral, are among the articles mentioned above which have until quite recently been supposed to be brass."

Silver exists in most countries side by side with lead, but the chief mines are in South America, and those of Pachuca in Hidalgo, Mexico, are said to be the first mines in which the Spanish forced slaves to work for them. Near there, is the Real Del Monte, where Peter Terreros, originally a poor muleteer, after a long labour found silver to the value of £3,000,000 sterling, and was rewarded with the title of Count by the Spanish monarch for the loan of £1,000,000, which was never repaid. Terreros invited his Majesty to the mine, promising him that wherever he should alight from his carriage it should be on a pavement of silver, and that wherever he lodged, it should be lined with the same metal. The King did not go; but when Terreros' own children

were baptized the procession is said to have walked on bars of silver.

Equally romantic was the finding of the Comstock Lode, and the subsequent rush to that spot, the enormous amount of money spent upon development and the colossal failure of the enterprise at the finish. The stories of the Leadville and Silverland Mining Enterprises are also fascinating; but all these belong to the romance of mining rather than of commerce.

Long, however, before the silver of the West was known to Europeans it was being worked in Spain by the Phœnicians, and Diodorus Siculus states that the anchors of ships returning from Spain were of silver. Earlier still is the record that in the days of Abraham silver was being used as a medium of exchange, not coined, but weighed.

Silver was a standard coinage in many countries before gold, and is still the standard in many countries. Usually, however, whenever gold has been adopted it has replaced silver, although sometimes the two are used together as a standard—that is to say, debts or exchanges may be made in either gold or silver to any amount. This is called a system of bimetallism, and is strongly advocated by some political economists. In England, where "monometallism" is in force, silver is only legal tender up to forty shillings. Before 1257, however, silver was the standard of value in England, and for five hundred years after both gold and silver were "standards."

In the Mint the process of coining silver is similar to that of gold, except in the final process of plunging into a furnace, when a different alloy is mixed with silver. During this process the alloy of copper is acted upon by the air, and forms a film of copper oxide, a film which is only removed by placing the

pieces of silver in a vessel of boiling acid, washing them afterwards in water and drying them in sawdust. The whole mass is thrown into large sieves through which the sawdust passes, leaving the silver pieces clean. The first silver coins issued in England were the silver penny, halfpenny, and farthing, copper pennies not coming into use until after the Great Fire of London. Edward I. coined the silver groat, or fourpenny piece, which was only withdrawn at the end of the nineteenth century.

China has rigidly adhered to a silver standard. One of her great officials recently stated the reasons. Here are his own words:

"As to the gold standard, we all know that it is a good standard, but China cannot adopt it, firstly because the amount of gold in China is not enough to make gold coins for circulation. If we buy gold from abroad, great expenses will be incurred. Should we purchase foreign gold, what are we going to do with the large amount of silver now in the market, which will cause a great panic in the financial world if the amount is not well disposed of. Secondly, because it is the temperament of the Chinese people to hoard precious metals. Those who see gold coins which are attractive will keep them if they are financially able to do so. They will probably hide the gold coins somewhere. The coins are the medium of exchange, and when they are thus stored up, the result will be great inconvenience to the public. For these various reasons, though knowing that the gold standard is a good one, we believe that it is not wise to adopt it abruptly. With regard to the gold exchange standard, it is usually adopted in countries where gold is scarce for the purpose of levelling the rate of foreign exchange. It serves its

purpose, and such a standard is mostly adopted in the colonies, where it proves useful. The reason is that the colony can always look up to the mother country for relief in time of need. The condition in our country is quite different, and thus no comparison can be formed between a colony and China. Supposing that we contract a big loan and that we put the borrowed money on the foreign market for the purpose of levelling in the rate of exchange, what will happen to us? It is most probable that we will experience the injury of the dealing before there is hope of profit therefrom."

In India also silver is greatly used, the standard coin being the silver rupee, worth about 1s. 4d. The annual output of silver is roughly about £25,000,000. India was recently the scene of an audacious attempt to corner silver.

A movement known as "Swadeshi" was initiated by native-born inhabitants of India with a view to conserve within their own hands the management of Indian affairs. The movement comprised the formation of banks, the officers and capital of which were all native; and *The Financial Times* thus describes the attempt and failure of one of these banks to corner silver:

"One of the most important of these institutions was the Indian Specie Bank, the capital of which was enthusiastically subscribed and whose Directors included Maharajas and other prominent native personages. Under these favourable auspices, the concern found no difficulty in obtaining an important share of native business, and enjoyed the advantage of a substantial amount of deposited funds. The managements devolved into the hand of Mr Chunilal Saraya, whose experience and abilities appear to have compelled the

Bank in the long run to entrust him with unchecked control over the operations and funds of that institution. This gentleman set himself to dominate the silver market in Bombay. Flattered by success and imbued with the idea, so fascinating to the Indian mind, of Napoleonic ventures in finance, he conceived the idea of cornering the world's supplies of silver.

"Mr Chunilal Saraya was doomed to failure for several reasons. He miscalculated the date when the Government of India would enter the market. He overlooked the fact that the production of silver is not only large, but automatic, for it goes on whether wanted or not, being mostly a by-product in the mining of other metals. He also forgot that the metal is exceedingly costly to carry when the stock assumes large proportions.

"In three or more years he found that, in order to keep up the value of his stock, he had to be constantly in the market as a buyer, and thus ever adding to his commitments. It is probable that at one time he must have been responsible for £6,000,000 of silver either in the form of actual silver or forward contracts. The accumulation of this vast quantity involved enormous expense in the form of interest and the cost of prolonging contracts for delivery and also necessitated the provision of margin.

"The only hope of retrieving the situation lay in the prospect of purchases by the Indian Government. These long-expected purchases were made at length, and the Indian Specie Bank succeeded in selling £3,000,000 to the Government in 1918 before the purchases were completed.

"On the 1st December last year the Indian Specie Bank came to the end of its resources and closed its doors with £3,000,000 of silver still in its hands."

Just before the Great World War there were violent fluctuations in silver, caused first by the cessation of supplies from Mexico at the outbreak of the revolution there, and by the subsequent supplies from that country, which had been accumulated, being forced upon the market; and later by the unsettled European situation which, during the latter part of July, made silver unsaleable, and there was no quotation for this commodity for many days. Then the British Government, through the Mint, made a large purchase of silver. France and Belgium followed, and later, the United States passed a special Bill authorising the purchase of 15,000,000 oz. of silver. During the war the British Government called in all the gold it could, and paper notes were substituted; but for a short time ignorant people looked askance at the notes and there was a rush for silver.

Bronze, the remaining metal used for coins as a medium of exchange, is not a pure metal, but a mixture of copper and tin. Many of the early nations used copper coins, and copper pennies were in use in England between about 1760 and 1860, when bronze was substituted. Bronze weapons also succeeded those of the Stone Age, only to be superseded later by the more formidable iron.

Copper itself, however, as an implement of warfare still maintains a conspicuous place as a metal of commerce.

Copper is a brilliant metal of a peculiar red colour. The only other metal anything like it in colour is titanium.

Like other minerals, copper is not only found in large quantities in mines, but its presence has been discovered in all kinds of soils and waters. You can trace it in seaweed, cheese, meat, eggs, straw and even in man's liver, kidneys and blood.

The earliest mining of copper appears to have been done by the Egyptians in the Sinai Peninsula, where the tunnels, crucibles and parts of the tools used may still be seen. They were worked from 5000 B.C. to 1200 B.C. In Europe also they must have been worked at a very early date, as in Spanish copper lodes there have been discovered flint mining implements and skulls of a prehistoric type.

Copper was known and worked by the Greeks and Romans and, alloyed with tin, it became the first metallic compound used by man, under the name of "bronze." The Romans worked copper in Britain and Spain; and in the latter country the copper mines of the Rio Tinto are still very valuable.

In the New World the copper districts of Lake Superior indicate that primitive man worked there, using stone hammers and hide bags to remove the metal hacked off in lumps. The Aztecs and natives of Peru also used bronze implements in their gold, silver, tin and copper mining, so they had discovered the usefulness of the alloy.

In modern times the uses of copper in war material are innumerable, and there is practically no alternative mineral. Take, for example, the cartridge cases. Those for rifles, with alloy of copper and zinc, are so thin that the metals must be very pure to ensure against flaws. Those for quick-firing guns must be exact to a five-hundredth part of an inch and gas-tight. On shells copper bands encircle the steel. Copper wire is also necessary for field telephones and dynamos. No wonder that during the Great European War Germany was paying £160 or more in gold for every ton of copper in any form delivered over the German frontier, although in Britain its value was only £60.

No wonder also that the Allies were taking every

precaution to keep copper from reaching Germany. For even in normal times the annual imports of that country in copper had been over 250,000 tons, while her own production of the metal was a little over 25,000 tons, and that of Austria about 4000 tons.

So important was the commerce in copper that there was almost a disagreement between England and the United States over the search of neutral ships for copper, and the British Foreign Minister based a portion of his reply to the American protest upon the extraordinary increases of imports in copper by Italy and other neutral countries close to Germany.

The United States, indeed, out of a world total of over 1,000,000 tons, exports over a half of this amount annually in copper, and the control of the copper market is practically in the hands of three firms.

Without copper no ammunition, and the greater the ammunition used the greater is the part which copper plays in its continuance or cessation. Before the Great World War broke out in 1914 Germany had recognised this fact and had laid in huge stores of copper, but so inadequate were these thought to be when the war was in progress, because of the extraordinary amount of ammunition used, that copper was sought eagerly by that country in any quarter and at any price. It was smuggled across the frontier in cotton bales and orange boxes; it was requisitioned from every factory in Belgium, and copper saucepans, crucifixes, holy-water basins and handles from railway stations were pillaged from that unfortunate country by the Germans; and, according to the *Frankfurter Zeitung*, even the electric light installations in Germany were dismantled for the sake of their copper. Thus was it reserved for copper in the twentieth century to determine the fate of empires.

Copper, like silver, has been the victim of a " corner," and in 1889 the enormous dealings in copper culminated in a disastrous debacle, spreading ruin far and wide, even to the suspension of banks. Not the least romantic episode in copper as a commercial commodity is the story of the vicissitudes of the Rio Tinto Copper Mine, said to be the largest in the world. This mine, covering eight square miles in extent, was worked by many wealthy people, including the Spanish Government, without success, but since its absorption by a large English company it has become one of the best-paying of mining concerns, and produces about one-tenth of the copper in the world. This story belongs to the romance of mining, but it is interesting from a commercial standpoint, because it shows that the Spaniards, while wasting their men and money in the New World, left their own wealth unexploited.

. . . .

Tin was probably used as a component of bronze in prehistoric times, but the first mention of it as an unalloyed metal is the record of it being imported from Cornwall and Scilly, and Spain, by the Phœnicians, who threw into the sea every foreign mariner who attempted to penetrate farther westward than Gibraltar in search of tin and amber.

Pliny and the Romans of his time did not make much distinction between tin and lead, but they imported tin and other metals from Spain.

Tinstone or cassiterite is now found in Cornwall, Malay Straits, Peru, Bolivia, Queensland, New South Wales and Nigeria, but the oldest of these tin-bearing areas is Cornwall, the mines of which, in spite of the efforts of the Phœnicians to keep them secret, soon became famous to the ancient world. Diodorus Siculus, a century before Christ, relates that the in-

habitants of Britain "prepare tin, working the earth which yields it with great skill. The ground is rocky but has earthy veins, the contents of which are brought down, melted and purified. After casting this into the form of cubes they carry it to a certain island adjoining Britain, called Iktis. During the ebb of the tide the space intervening is left dry and they transport there quantities of tin in carts. From hence the merchants buy tin from the natives and carry it into Gaul, and through Gaul on foot for thirty days to the mouth of Rhone."

At a later date Cornish tin became one of Britain's principal exports, and English monarchs dabbled in tin speculations, not always successfully. In this connection Sir Isaac Newton tells an interesting story of Queen Anne:

"The 1600 tunns of tin bought annually in Cornwall amounts, in merchant's weight, to 1714 tunns yearly, and in all seven years to be 12,000 tunns. Between April 6, 1704, and September 12, 1705, there has been sold by the Pewterers 600 tons, by the officers of the Mint 488 tons, and by Mr Drummond about 1000 blocks, or 144 tons—in all 1232 tons. The Queen pays annually for tin, £112,000, salaries £3000, carriage by sea £3000, incidental charges about £1200—in all £118,200; and in all the seven years £827,000, besides interest. Her Majesty has received . . . £65,360 annually, and in all the five and a quarter years to come £343,140. Deduct the £65,360 from the £118,200, and the £343,140 from the £827,400, and the Queen will run in debt yearly £52,840, and at the end of the time of the bargain will be in debt £484,260, besides interest, which amounts to about £72,000 more; so that the whole debt will be about £556,000."

In more modern times the Malay Straits and the tin-fields of Nigeria have attracted the tin-seeker elsewhere, but the Cornish miner is still sought even in these remote quarters of the globe.

The only important ore of tin is tinstone or cassiterite, which occurs in granite rocks of coarse texture. It is widely distributed, but is only found in paying quantities where the heavy metal has been washed from its granite source in the process of erosion and weathering, and has collected in gravel and sand as a placer deposit termed "stream tin." Tin mines, wherever they exist, have been discovered by tracing these stream deposits back to their source in some parent granite or associated rock.

For extracting the tin from the tinstone the crude ore is pounded and the lighter gangue washed away with water. The washed ore is then roasted to remove the arsenic, sulphur and other impurities still remaining, the purified ore, known as "black tin," afterwards going to the furnace.

An ingot of pure tin is almost pure white. A slight tinge of blue is the only discolouring. It is lustrous, soft and elastic, and does not tarnish upon exposure to the air. Its crystalline nature you can detect by the characteristic crackling noise a sheet or bar makes when bent. When rubbed it gives a peculiar odour; at a temperature of 200° it becomes brittle, at 228° it fuses, and when raised to a white heat it enters into ebullition and burns with a brilliant white light.

Good ore should yield 6 per cent. black oxide containing 78 per cent. of metal.

Iron, of all the important metals, was the last to be employed generally and extensively, although when so used it quickly eclipsed in importance all the other metals. Yet iron is to be found in almost every

country in the world, and so much is there in India that it must have been known in that country in early times.

We know indeed that the African natives have used it from time immemorial, and that it is mentioned in the Bible at a very early stage, Tubal Cain being described as "an instructor of every artificer in brass and iron"; that on the sepulchres of the Egyptian Thebes, butchers are depicted as sharpening their knives on a round bar of iron, while the weapons of Rameses III. are painted blue to indicate they were of steel, in contrast to those of bronze, which are painted red; while the British Museum exhibits include iron knives, picks and hammers from Nineveh, of a date about 3000 B.C. We read also that iron was discovered in Mount Ida about 1406 B.C., that the Romans mined it in Britain 54 B.C., that the Spartans and ancient Britons used bars of iron for money, and that the Philistines carried off all the "smiths" after their conquest of the Israelites. Yet among Greeks and Romans it appears to have been little used. Why was this?

The principal explanation is due to the superstitious fear of iron which these people appear to have felt. Plutarch tells us it was unlawful to introduce any iron implement into a Greek temple, and no Roman priest might be shaved by an iron razor or use iron scissors. Even surgical knives, though of steel, bore on the opposite side from the actual blade a leaf-like projection of bronze with two edges, a survival of the earlier bronze blade, preserved for ceremonial reasons. The superstitions connected with Vulcan and Thor survived long after the Christian era, and many a legend clings round ancient "smithies."

Perhaps one reason for these superstitions is that

iron is only found pure in the form of meteorites or "lumps of iron from heaven."

Iron ore itself in colour does not suggest its connection with commercial iron and steel; and its extraction is no easy matter.

Magnetite, or magnetic iron ore, which contains over 60 per cent. of iron, is found principally in Sweden and the Lake Superior district in the New World. The iron from the Swedish mines of Dannemora is said to be the purest in the world, yielding at least 66 per cent. of metal. The owners limit the output to about 50,000 tons per annum, and keep a special price.

Hæmatite iron, brown or red, including limonite, lake ore, etc., contains a slightly less percentage of true metal, and is found principally in the Spanish province of Biscay, Elba, Algeria, Mexico and Lake Superior, but there are immense deposits in Siberia, Russia, China, Australia and Africa as yet untouched.

The story of iron and steel manufacture, and the methods of working the metal, belong rather to the romance of mining; but one cannot conclude without calling attention to the important revolution in warfare produced by iron. As Rameses conquered the ancient world by his iron implements, so later civilisation conquered barbarism, and invention overcame indifferentism. Even the Turks, originally slaves working iron for their masters the khans, turned the tables on their rulers by using the weapons they forged for them. Later still, when sea power became all-important, iron decided the day.

Where the first iron ship was built is uncertain, but there is a record of one launched on the River Foss in Yorkshire for passenger service in 1777; and a few years later iron was being used for shell plating of lighters in the canals, and the iron *Vulcan* was floated on the

Monkland Canal, Glasgow. Many, however, were the prejudices against iron ships for quite half-a-century. "Don't talk to me of iron ships," said a famous naval constructor at the beginning of the nineteenth century. "They are contrary to nature." Another argument against them was that if they grounded, and were thus exposed to bumping on a shore, the bottom would be easily perforated. This was refuted by the grounding, in 1846, of the *Great Britain*, the first large screw steamer built of iron. Though she remained aground for eleven days, she was finally refloated, repaired and restored to active service.

The fight between the *Merrimac* and the *Monitor*, in 1862, during the Civil War in America between the Northern and Southern States, decided, it is said, the superiority of iron over wood for the man-of-war.

With good cause is the last age of civilisation called the Iron or Steel Age.

Platinum is a strange, silvery-looking metal which expands when heated at almost the same rate as glass. Platinum wire can, therefore, be melted into glass without the danger of the glass cracking when both cool, hence its use in the glass bulbs of electric lamps.

It is heavy, can be beaten out or drawn out readily; but it is almost unacted upon by air or acids. It has the strange property of absorbing considerable quantities of gases like hydrogen; and, besides its use for incandescent bulbs, it is turned into jewellery, and is used in photography and for the manufacture of chemical apparatus. One of its uses belongs to an obscure chemical operation known as *catalysis*. Sir Humphry Davy, just a century ago, exhibited what he called a "lamp without flame." He suspended a spiral of platinum in ether whose vapours joined on the platinum with the oxygen of the air causing the metal

to glow. The point of this and similar experiments is that the ether might be left in contact with the iron for ages without any change taking place. We may keep a mixture of oxygen with double the amount of hydrogen in a closed vessel almost as long as we like without any action taking place. We know that these are the ingredients of water, and that if we brought a flame near or introduced an electric spark there would be a flash and an almost instantaneous chemical change. But we can produce the same result if we introduce a clean strip of platinum foil. The combination takes place. Water is produced; and sometimes the platinum begins to glow and the last of the gases explode. If the platinum be examined afterwards it is no lighter in weight and no change can be found in it. If it be kept quite clean and not fingered it can be used for the same mysterious operation again.

There are a number of other instances of catalysis in which platinum has been used. Some of them have not as yet been applied industrially, though students have seen the method employed in the laboratory. Such an experiment is the passing of air or oxygen into a flask containing a solution of ammonia and a spiral of platinum wire. At first the flask is filled with dense white fumes of ammonia compounds; but later, when the oxygen is passed in quickly, orange fumes of nitrogen peroxide appear, and the explosive gases at length take fire from the glowing platinum. The nitrogen peroxide being of the greatest value for the production of nitric acid some use has been made of the process in Germany.

Platinum was first found in South America, and was then named from its appearance, *platina* being the Spanish diminutive of *plata* (silver). But it has been called *polyxene* because it is so hospitable to other

minerals that it is rarely found alone. Almost invariably it has some traces of the similar metal in the Mendeléef group and table—osmium, iridium, ruthenium, rhodium, palladium. Very often, too, it is found in gold deposits, and with copper or iron. Sometimes it is found as cubic crystals; sometimes as flattish scaly grains; sometimes as nuggets. Most frequently, however, it is found in sandy deposits; and in the Middle Urals, where the most famous deposits are situated, nuggets up to 20 lbs. in weight have been discovered.

It was said that the Bolsheviks paid for their propaganda in Denmark by large consignments of platinum, the amount sent to Copenhagen being valued at £20,000. As about 95 per cent. of the available platinum comes from Russia, the Government controlling that part of the country from which come such stocks has a very valuable source of wealth.

CHAPTER XXV

AIRCRAFT IN WAR AND COMMERCE

THERE is no last chapter in the Romance of Commerce, for there are no limits to the means and possibilities of transport whereby human wants and cravings may be satisfied. Less than two hundred years ago there were no railroads. Fifty years ago there was no road motor transport. The dawn of the twentieth century saw no aircraft hovering upon the horizon, nor did it give an indication of the revelations and revolutions that were to be born before the first generation of the new century had passed away.

But though there can be no last chapter in the Romance of Commerce, the story told in these pages would be incomplete without a few words upon the latest means of locomotion, which has already proved the most potent weapon of war, and promises to provide for Peace the swiftest source of communication and transport.

At the beginning of the World War Britain was behind other big Powers in aircraft production. Airships were ridiculed, and only after midnight raids by the enemy on England and on the various fronts did Britain awake to the importance of securing supremacy in the air.

It is now possible to disclose the various steps by which Britain gained that supremacy in the air which was one of the chief causes of Germany's sudden collapse.

The earliest type of British reconnaissance machine

was the B.E.2C, designed and produced by the Royal Aircraft Factory at Farnborough. Its best speed was 60 miles an hour.

Towards the end of 1916 the Royal Aircraft Factory produced the R.E.8, which has done the bulk of the artillery observation work in France. It can reach 10,000 feet in eleven minutes, is fitted with wireless and takes photographs of every "shoot."

An even bigger advance was marked by the "Bristol Fighter," a long-distance fighting reconnaissance machine, capable of 113 miles an hour at 10,000 feet, and climbing to that height in eleven minutes.

Aerial bombing was first undertaken in France by the Avro. The observer's seat was used as a receptacle for the bombs, which were merely thrown overboard without the aid of the present scientific bombing sights and elaborate gear.

The first British machine specifically constructed for bombing purposes was the Short, a modified seaplane, fitted with a 250 h.p. engine and carrying four 112 lb. bombs under each wing. The present bomber is the D.H.4, which was originally designed as a fighter, but disclosed such excellent lifting powers that it was converted to bombing purposes. It is capable of climbing to 10,000 feet in nine minutes and has an endurance of 3¾ hours.

Finally, the great Handley Page machines were devised for the bombing of Germany. They are capable of carrying 2000 lbs. of bombs in the fuselage, or 1500 lbs. to be suspended externally.

The fighting scouts have seen a similar development, and have culminated in the Sopwith Dolphin, which travels at 128 miles an hour at 10,000 feet, and can reach that height in 8¼ minutes.

In August, 1914, the Flying Services consisted of

285 officers and 1858 other ranks. In November, 1918, the Royal Air Force strength was 30,000 officers, 260,000 men and about 30,000 women and boys.

With the conclusion of the Armistice in 1918 attention was at once concentrated upon the possibilities of aircraft for the peaceful purposes of commerce and communication. It was recognised that the commercial aeroplane was going to be a very powerful colonising agent and would in the next few years, if not in the next few months, open up new countries and revolutionise the conditions of transport and life in many of the old ones.

Mails can be carried from London to Edinburgh in little more than three hours, which means that a letter could be despatched and an answer received within the limits of an ordinary business day. The London mail, the recent Aerial Transport Committee estimated, could be conveyed to India in four days, instead of sixteen, as by post, and with progressive improvement in design and construction the time will be still further shortened.

We now possess aeroplanes which carry a crew of seven and thirty passengers, which climb to a height of 10,000 feet, travel at 100 miles an hour and can make a journey of 1200 miles without a stop. We possess such machines for travel over land and similar machines which, if necessary, can come down on the surface of the seas, float and rise again with their full load.

Already we have machines so devised that they can land safely at definite gliding angles entirely without human control. This means that, when the pilot can set his instruments by means of a kite balloon anchored in clear air, he will be able to land with safety in an aerodrome completely fog-bound.

It is possible to leave London by aeroplane at

10.30 A.M., reach Paris for lunch, transact business and return to London before one's office closes. By the time this book is published there will probably be air services to Marseilles and Egypt, with alternate visits to South Africa via the west and east coasts. The British West African Association was one of the first educational and commercial bodies to recognise the value and importance of aircraft in commerce and to negotiate with the Air Ministry for the necessary facilities for an air service to West Africa.

Aeroplanes have also opened a new field for preliminary survey. Whereas, in the past, millions of pounds and a great amount of time were expended in exploratory survey in bush and timber country by the old methods, nowadays, by means of aerial photography, an enormous area of new country may be as accurately mapped as in the days of the theodolite, chainman and axeman, in a shorter time and at less expense. And there will be the additional advantage of a true portrayal of the special landmarks on the ground and the taking in of all intervening country that was only roughly estimated in the earlier days.

The photographic expert can tell approximately from the light and shade effects the elevation of contours. The height of prominent ridges, hills and mountains can be ascertained with sufficient accuracy by flying low over them and taking the altimeter readings on the instrument-board of the aeroplane. The pocket altimeter was usually utilised in the old days with no greater accuracy.

The Handley Page and similar aeroplanes have a great future before them for commercial purposes. To some experts the airship is believed to be of greater promise for distances over a thousand miles than the aeroplane. Their argument is :

"Aeroplanes do not appreciably increase in efficiency as they increase in size. Airships most emphatically *do*. For example, an existing 66-ton ship has a useful carrying lift of 33 tons.

"The days when large airships require hundreds of men to haul them in and out of their sheds are ending—soon they will moor like any sea-going ship, and only go into a shed in the same circumstances as a ship goes into dry dock. The difficulty of handling and landing large aeroplanes, on the other hand, is increasing considerably as the aeroplane increases in size.

"Whereas the cost of hydrogen used to be almost prohibitive, it is now very much reduced, and the consumption will shortly be so decreased as to make the hydrogen question of comparatively minor importance."

Flights in an aeroplane and in an airship are scarcely comparable. The aeroplane "banks," descends and climbs steeply, is surrounded with "noise," the wind whistles on the wires and is very worrying to the non-expert.

But in the airship sleeping is a thing of calm joy, no "banks," no wires to whistle, engines very quiet and easily throttled back, with no fear that engine failure is a life and death affair.

The success of the operational side of air transport will depend upon (*a*) the development of the navigational instruction by really sound and severe navigational training; (*b*) the creation of an energetic meteorological service specially designed to help air transport; (*c*) the adoption of improved systems of wireless telegraphy and telephony, and the adoption of a first-class system of day and night marking of landing-places and aerodromes. When these measures are taken there will be no more difficulty in navigating an

aeroplane in foggy or otherwise bad weather than in navigating a ship.

The Air Ministry is keenly alive to the needs and possibilities of aircraft, and its admirable scheme of education within the Royal Air Force should render that body the finest war service in the world, besides producing pioneers for aviation in commerce.

We stand on the edge of a new epoch in the history of mankind. In the air we have just conquered a new element of inconceivable immensity.

The span of the world has shrunk to a quarter of its former size. Where we thought in countries, now we think in continents. Where we thought in days, now we think in hours.

We have the power of throwing a girdle round the earth.

Remote Australia suddenly draws close. Greenland and Spitzbergen loom beside us. Rome, Christiania and Amsterdam seem to be but foreign suburbs of London.

No longer is Japan an unattainable dream. The Nile lies but a day and a half away. On glorious honeymoons we can slip away into the star-beflowered darkness of the East to drift and steal at sunset to the Southern Seas.

And when Marconi and the mysteries of wireless telegraphy have succeeded in establishing communication with Mars, who knows but that the Romance of Commerce, at present confined to the limits of our own planet, may not be extended to a distant orb.

INDEX

A

ABYSSINIA, 53
Afghanistan, 85
Africa, author in, 21, 65. 129, 153
Air service to Egypt, 290
Alaska, 28
Alligator skin, 184
Alpaca, 149
Amber, 263-264
Antiquaries, 265
Apple, 171
Arabs, 55, 74, 247
Argentine, 32, 39
Arrowroot, 31
Asphalt, 210
Assam, 44
Assyria, 17, 29
Australia, 147, 161, 173
Australians, native, 241
Aztecs, 64

B

BACON, FRANCIS, 191
Balata rubber, 112
Baltic Exchange, 40
Bamboo, 246
Banana, 55, 67, 175-176
Barbados, 78
Barley, 28, 33
Barter, 18
Beaver, 223
Beetroot, 36
Beet sugar, 78
Bimetallism, 272
Bison, 182
Bitumen, 209
Black fox, 221-222
Blotting-paper, 250
Bolshevists and platinum, 286
Brass, 282
Brazil, 59, 60, 73, 100, 254
British West African Association, 290
Britons, ancient, 265, 280
Bronze, 276
Buffalo, 182
Bullfighting, 179-180
Buttons, 26

C

CALIFORNIA, 28, 174
Camel-hair, 149
Cameroons, 70, 72
Canada, 159, 161
Canals, 25
Canary Islands, 176

Caravans, 21
Carthaginians, 17, 266
Cashmere, 149
Castilloa rubber, 105
Catch crops, 55
Cattle, used as money, 178
Cedar, 156
Ceylon, 45, 57, 96-97
Champagne, 170
Chile, 36
Chinese, 20, 43, 48, 127, 137, etc.
Chocolate, 62, 71
Cider, 172
Cigars, 124
Cinnamon, 95
Clippers, tea, 49
Clothes, human, 182
Cloves, 92
Coco-nut, 202
Coco-nut oil, 205
Coins, 265
Commercial Sales Rooms, 49, 70
Congo, 56, 98
Copper, 277
Copper mines in Sinai 5000 B.C., 277
Copra, 205
Corundum, 255
Cowries, 239
Craft guilds, 19
Crocodile leather, 184-185
Cuba, 83, 118
Currants, 168

D

Delmonte process, 211
Diamond, 252
Diesel engines, 214
Dishonest traders, 26
Druids, 157
Dutch, 41, 54, 91, 95
Dyeing, 163

E

Egyptians, ancient, 22, 29, 35, 127, 246, 277, 282-283
Eiderdown, 231
Emerald, 257
Ermine, 221, 225
Eskimos, 18
Eucalyptus, 161

F

Fir, 161
Fish skins, 189
Flemish weavers, 143
Florida, 174
Freedom and commerce, 19
Funtumia rubber, 103

G

Germans and cold storage, 195

Germans and vegetable oils, 208
Ginger, 93
Goatskins, 188
Gods and commerce, 178
Gold, 265
Gospel Oak, 157
Grapes, 167
Greeks, 22, 87, 127
Guinea, 269

H

Hæmatite, 283
Halfpenny newspapers, 245
Hanseatic League, 19
Harmsworth's Paper Mills, 248
Hemlock, 163
Herodotus, 266
Hevea rubber, 103
Himalayas, 44
Humphry Davy, 284
Hungarian ox, 180

I

Iced drinks in Rome, 191
Incas, 31
India, 45, 78, 127, 131, etc.
India-rubber, 99
Intoxicants, 167
Iron, 281
Ishmaels, 21
Ivory, 101

J

Jade, 259
Jamaica, 56, 176
Japan, 44, 73, 137
Jarrah trees, 161
Java, 44, 56, 73, 83, 98
Jews, 20
Julius Cæsar, 18
Julius Cæsar and bull-fights, 160

K

Kernels, 200
Koh-i-nur diamond story, 253

L

Lake-dwellers, 33
Lard, 207
Leverhulme, Lord, 198
Liberian coffee, 56
Lime juice, 94
Lumber King, story of the, 163

M

Mackintoshes, 100
Madagascar, 91, 102
Magnetite, 282
Mahogany, 154

Maize, 30
Malay Straits, 97, 104
Malt, 34
Maple sugar, 80
Margarine, 202
Medicine-man, 204
Merchant guilds, 19
Merino wool, 144
Mexico, 64, 99, 114, 128, 267-268, 271
Millet, 28
Miniver, 225
Mohammedans, 53
Molasses, 76
Money, 20, 21
Moneylending, 20
Mother-of-pearl, 242, 261
Motor cars, 97
Mulberry-tree, 137, 246
Murrain, cattle, 181
Mustard, 87

N

NAPOLEON and beet sugar, 78
Newfoundland, 247
New Zealand, 148
Nigeria, 70, 71, 129
Nineveh and iron, 282
Nutmeg, 95

O

OAK, 157, 163, 183
Oats, 30, 32
Oil fuel, 216
Oil palm, 198
Opal, 259
Opossum, 227
Orange, 173
Orloff diamond story, 254
Ostrich feathers, 283

P

PALESTINE, 87
Paper-ware, 250
Papier mâché, 250
Papyrus, 246
Paraguay tea, 46
Pearl-fishing, 241, 261
Pepper, 90
Pepys, 42, 191
Persians, 137
Peru, 31, 64. 99, 128, 218
Petroleum, 209-213
Phœnicians, 22, 266, 272, 279
Pine wood, 161
Platinum, 284
Polenta, 31
Porpoise, 184
Portuguese, 267
Potato, 30
Primitive commerce, 241

Q

QUEENSLAND, 73, 241-242
Quills, 231

R

RAG-PAPER, 247
Railways, 24
Raisins, 168
Razors, 282
Reaping, 87
Regent diamond story, 254
Rice, 21, 30
Roman roads and laws, 18, 23
Romans and iron, 282
Romans and silk, 136
Rubber Growers' Association, 115
Rubies, 255
Rumanian oil, 218
Russia, 32, 34, etc.
Rye, 34

S

SABLE, 223
Saccharin, 81
Salt, 85
Sapphire, 255-257
Sawdust, sugar from, 82
Scissors, 282
Sea-lion, 187
Sea-otter, 224
Seals, 185, 225
Seville orange, 173
Shale oil, 211, 217
Sheep-skins, 188
Shell money, 238
Shipping, 22-23
Siberia, 29, 65
Sierra Leone, 30, 70, 72, 93, 229
Silkworms, 135
Silver, 271
Slave trade, 21
Smiths, 282
Smoking, 118
Snow, effect on timber, 161
Snuff, 118
Soap, 201
Solomon, 266
Soya bean oil, 201
Spaniards, 99, 143
Spanish slaves, 271
Spartans, 282
Spelt, 35
Squirrels, 227
Stage-coaches, 24
Stearin, 207
Steel, 282
Sudan cotton, 130
Suez Canal, 26
Sugar-cane, 74
Sumatra, 58, 91
Superstitions, amber,
— cattle, 179
— diamonds, 253
— opal, 259
— iron, 282
Swadeshi, 274
Switzerland, 32

T

TANNING, 163-164, 183
Tasmania, 172
Tea tax and war, 42

Tea-testing, 50
Tin, 279
Togoland, 70, 72
Topaz, 255
Transvaal, 261
Treacle, 76
Turkestan, 35
Turkey, 120
Turks and iron, 289
Tyre and Sidon, 17

U

Unleavened bread, 38

V

Venice, 17, 22, 86
Vineyards, 167

W

Wafers, 38
War and commerce, 18
West Africa, 30, 54, 90, 93-94, 98, 102, 129, 154, 254, 266
West African Association, 290
West Australia, 241
Wheat, 28-29, 35
White ants, 108
Wine, 167-169

Z

Zanzibar, 91-92

THE RIVERSIDE PRESS LIMITED, EDINBURGH
1920

THE

ROMANCE OF MODERN ASTRONOMY

By HECTOR MACPHERSON, Junior

With Thirty-two Illustrations and Diagrams. Extra Crown 8vo.

"Simply and clearly written. It is a perfect book for a school library. Great care, taste and learning have been expended on the pictures. The best of a very useful and well-written series."—*Manchester Guardian.*

"The illustrations are exceedingly good. . . . An excellent compendium of the most interesting facts in astronomy, told in popular language."—*Athenæum.*

"Described with the utmost clearness, and even with charm."—*Daily Graphic.*

"This work should greatly appeal to any young student of the subject by its lucid and picturesque language."—*Field.*

THE ROMANCE OF THE SHIP

THE STORY OF HER ORIGIN AND EVOLUTION FROM THE EARLIEST TIMES

By E. KEBLE CHATTERTON, B.A. (Oxon.)

Author of "Sailing Ships and their Story," &c. &c.

With Thirty-three Illustrations.

"Entertaining and instructive."—*Spectator.*

"A fascinating volume full of information and stirring incident."—*Queen.*

"A very delightful story of the evolution of the ship."—*Sheffield Telegraph.*

"A veritable mine of information and instruction."—*Standard.*

THE ROMANCE OF AERONAUTICS

AN INTERESTING ACCOUNT OF THE GROWTH AND ACHIEVEMENTS OF ALL KINDS OF AERIAL CRAFT

By CHARLES C. TURNER

Holder of the Royal Aero Society's Aviation Certificate,
Author of "Aerial Navigation of To-day," &c. &c.

With Fifty-two Illustrations and Diagrams. Extra Crown 8vo.

"A capital survey by an expert writer."—*Guardian.*

"Brightly written, exceptionally well illustrated, and shows a due regard for historical accuracy."—*Aeronautics.*

"A most interesting book."—*Spectator.*

"A most complete history . . . told with lucidity and enthusiasm, and brimful of interest."—*Truth.*

"Set forth with a persuasive and accomplished pen."—*Pall Mall Gazette.*

SEELEY, SERVICE & CO. LIMITED

THE SCIENCE OF TO-DAY SERIES

With many Illustrations. Extra Crown 8vo. 7s. 6d. nett

NEW VOLUME

AIRCRAFT OF TO-DAY. A Popular Account of the Conquest of the Air. By Lieut. CHARLES C. TURNER, R.N.V.R. With 62 Illustrations

"Lieut. Turner is well known as an authority on aeronautics. Of real value."—*Aberdeen Journal.*

GEOLOGY OF TO-DAY. A Popular Introduction in Simple Language. By J. W. GREGORY, F.R.S., D.Sc., Professor of Geology at the University of Glasgow. With 55 Illustrations. Extra Crown 8vo.

"An ideal introduction to a fascinating science. The romance and reality of the earth most brilliantly and soundly presented."—*Globe.*

SUBMARINE ENGINEERING OF TO-DAY. A Popular Account of Submarine Engineering. By C. W. DOMVILLE-FIFE, Author of "Submarines of the World's Navies," *&c.*

BOTANY OF TO-DAY. A Popular Account of the Evolution of Modern Botany. By Prof. G. F. SCOTT-ELLIOT, M.A., B.Sc., Author of "The Romance of Plant Life," *&c. &c.* Extra Crown 8vo.

"This most entertaining and instructive book. It is the fruit of wide reading and much patient industry."—*Globe.*

SCIENTIFIC IDEAS OF TO-DAY. A Popular Account, in Non-technical Language, of the Nature of Matter, Electricity, Light, Heat, Electrons, *&c. &c.* By C. R. GIBSON, F.R.S.E. Extra Crown 8vo.

"As a knowledgeable writer, gifted with the power of imparting what he knows in a manner intelligible to all, Mr C. R. Gibson has established a well-deserved reputation."—*Field.*

ASTRONOMY OF TO-DAY. A Popular Introduction in Non-technical Language. By CECIL G. DOLMAGE. LL.D., F.R.A.S. 46 Illustrations. Extra Crown 8vo.

"A lucid exposition much helped by abundant illustrations."—*The Times.*

ELECTRICITY OF TO-DAY. Its Work and Mysteries Explained. By CHARLES R. GIBSON, F.R.S.E. Extra Crown 8vo.

"One of the best examples of popular scientific exposition that we remember seeing."—*The Tribune.*

ENGINEERING OF TO-DAY. A Popular Account of the Present State of the Science, with many interesting Examples, described in Non-technical Language. By T. W. CORBIN. 39 Illustrations. Ex. Cr. 8vo.

"Most attractive and instructive."—*Record.*

MEDICAL SCIENCE OF TO-DAY. A Popular Account of recent Developments. By WILLMOTT-EVANS, M.D., B.Sc., F.R.C.S.

"A very Golconda of gems of knowledge."—*Manchester Guardian.*

MECHANICAL INVENTIONS OF TO-DAY. An Interesting Description of Modern Mechanical Inventions told in Non-technical Language. By THOMAS W. CORBIN. Extra Crown 8vo.

"In knowledge and clearness of exposition it is far better than most works of a similar character and aim."—*Academy.*

PHOTOGRAPHY OF TO-DAY. A Popular Account of the Origin, Progress, and Latest Discoveries in the Photographer's Art, in Non-technical Language. By H. CHAPMAN JONES, F.I.C., F.C.S., F.R.P.S.; Pres. R.P.S.; Lecturer on Photography at Imperial College of Science.

"An admirable statement of the development of photography from its very beginning to the present time."—*Journal of Photography.*

SEELEY, SERVICE & CO., LIMITED